

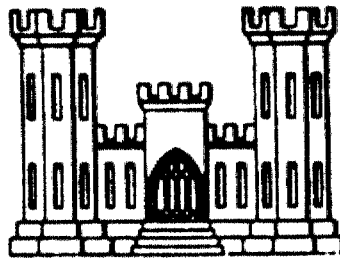
NEPONSET RIVER FLOOD CONTROL

CANTON

LOCAL PROTECTION

EAST BRANCH NEPONSET RIVER , MASS.

GENERAL DESIGN MEMORANDUM



U.S. Army Engineer Division, New England
Corps of Engineers Waltham, Mass.

MARCH 1959

11

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD
WALTHAM 54, MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

MEMO

23 March 1959

SUBJECT: Submission of General Design Memorandum, Local
Protection Project, East Branch Neponset River,
Canton, Massachusetts

TO: Chief of Engineers
Department of the Army
Washington, D. C.
ATTENTION: ENGWD

1. There are submitted herewith for review and approval ten (10) copies of General Design Memorandum entitled "Local Protection, East Branch Neponset River, Neponset River Flood Control, Canton, Massachusetts." The location and general plan of recommended improvements are designated in this memorandum. Minor adjustments will be required as more complete information becomes available from final design investigations.

2. On 16 March 1959, the Town Meeting of Canton voted to comply with the local cooperation required by the Flood Control Act of 1936 and Public Law 685 as set forth in the General Design Memorandum for the recommended project. Formal assurances of participation will be obtained from local interests during the preparation of the contract plans and specifications for the approved project.

3. Local interests desire the construction of the recommended plan for diverting flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant. They state that the Plymouth Rubber Company is the largest single employer in Canton and it has a major effect on the town's economy through its payroll, local purchases of materials and services, and by the consumption of goods purchased in the town by its employees. They state further that, because the recommended plan would eliminate flooding of the Plymouth Rubber Company plant, the gates of Forge Pond Dam, upstream of the plant, could be opened during flood periods and thereby reduce flooding in Canton adjacent to this body of water.

4. The plans and specifications will be prepared in accordance with the Design Memorandum as approved. Copies of the plans and specifications will be forwarded to the Chief of Engineers at the time of advertisement for bids for the contract work.

MEMO

23 March 1959

SUBJECT: Submission of General Design Memorandum, Local
Protection Project, East Branch Neponset River,
Canton, Massachusetts

5. Funds are requested in the amount of \$10,000 for preparation of plans and specifications, and in the amount of \$184,000 for construction.

6. If approval of this design memorandum and the allotment of the requested funds are forthcoming in the near future, the recommended project will be substantially constructed by December 1959.

7-2-1 Design Memo
(cyc 7-10, incl)

STANLEY E. OZIERAN
Colonel, Corps of Engineers
Acting Division Engineer

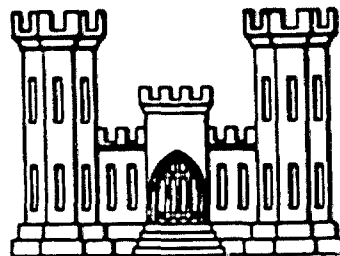
NEPONSET RIVER FLOOD CONTROL

CANTON

LOCAL PROTECTION

EAST BRANCH NEPONSET RIVER , MASS.

GENERAL DESIGN MEMORANDUM



U.S. Army Engineer Division, New England
Corps of Engineers Waltham, Mass.

MARCH 1959

LOCAL PROTECTION PROJECT
EAST BRANCH NEPONSET RIVER
CANTON, MASSACHUSETTS

DESIGN MEMORANDUM

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LOCAL PROTECTION PROJECT
EAST BRANCH NEPONSET RIVER
NEPONSET RIVER BASIN
CANTON, MASSACHUSETTS

GENERAL DESIGN MEMORANDUM

March 1959

1. PERTINENT DATA

Physical Features

1. Location - That reach of the East Branch Neponset River adjacent to the Plymouth Rubber Company plant in the town of Canton.

2. Type of Improvement - Flood diversion channel, including a concrete overflow dam, concrete walls, dikes, rock and common excavation, rockfill bank protection work and topsoil and seeding.

3. Length of Improvement

a. Channel excavation	2,000'
b. Rockfill bank protection	2,200'
c. Dikes	1,100'
d. Concrete walls	200'

4. Hydrology

a. Maximum flood of record (August 1955)	
East Branch Neponset River at Canton	1,790 c.f.s.
b. Project Design Flood for East Branch	3,000 c.f.s.
c. Project Design Flood for Diversion	
Channel	2,100 c.f.s.

5. Channel Dimensions

a. Bottom width	60'
b. Side slopes	1 vertical on 2 horizontal

6. Dike Dimensions

a. Top width	10'
b. Freeboard above design flood	3'

7. Concrete Overflow Dam

- a. Length 156'
- b. Maximum height 8'

8. Cost Estimates

a. <u>First Costs:</u>	Federal	\$218,000
	Non-Federal	<u>17,000</u>
	Total	235,000
b. <u>Annual Costs:</u>	Federal	7,700
	Non-Federal	<u>1,300</u>
	Total	\$ 9,000

9. Benefits

- a. Average Annual Benefits \$ 44,000
- b. Benefit-Cost Ratio 4.9 to 1.0

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
OFFICE OF THE DIVISION ENGINEER
424 Trapelo Road
Waltham 54, Mass.

LOCAL PROTECTION PROJECT

EAST BRANCH NEPONSET RIVER
NEPONSET RIVER BASIN
CANTON, MASSACHUSETTS

GENERAL DESIGN MEMORANDUM

March 1959

2. AUTHORITY

This design memorandum is submitted pursuant to authority contained in Section 205 of the Flood Control Act of 1948 as amended by Section 212 of the Flood Control Act of 1950 and Public Law 685, 84th Congress, 2d Session. Further authority is contained in letter dated 17 October 1956 from the Chief of Engineers in reply to letter dated 18 September 1956 from the Division Engineer, New England Division, subject: "Local Protection Project, East Branch of Neponset River, Canton, Massachusetts."

3. SCOPE OF DESIGN MEMORANDUM

3.1 Scope. This design memorandum reviews the flood control problem in Canton, Mass., in the watershed of the East Branch Neponset River, also known as the Canton River, a tributary of the Neponset River, and submits a definite project for flood control by the diversion of flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant.

3.2 Topographic surveys. Plane table surveys were made, on a scale of 1"=50' and a contour interval of 2 feet of the sites for proposed projects for diversion of flood flows of the East Branch Neponset River and Massapoag Brook.

3.3 Subsurface explorations. A geological reconnaissance has been made of all potential local protection sites in the vicinity of Canton, Mass. Subsurface explorations were made at two sites;

the proposed division of flood flows of the East Branch Neponset River and the proposed diversion of flood flows of Massapoag Brook.

3.4 Flood damage surveys. Preliminary damage surveys were made in the principal flood areas of the Neponset River Basin immediately after the flood of August 1955. Additional surveys were conducted during 1957 in the East Branch Neponset River and Massapoag Brook watersheds. The surveys consisted of door-to-door interviews and inspections with owners, tenants, or officials of the various residential, commercial, industrial, and public properties affected by flooding. The results of the flood damage surveys are summarized in Section 11 of this design memorandum.

3.5 Real estate studies. Field reconnaissance and determination of recent sales in Canton, Mass., were used as the basis for estimates of real estate costs.

3.6 Conferences with local interests. Close liaison has been maintained with state and town officials, local property owners and other interested parties. Preliminary plans for the proposed work have been reviewed by representatives of these agencies. Desires of local interests are described in Section 24.

4. PRIOR REPORTS

4.1 NENYIAC Report. The report entitled "The Resources of New England-New York Region" was prepared by the New England-New York Inter-Agency Committee under the directive contained in Presidential Letter of October 9, 1950. Part Two, Chapter XVI of the NENYIAC Report, entitled, "Massachusetts Coastal Area" includes data on the Neponset River.

4.2 Corps of Engineers reports. There are no Corps of Engineers reports on flood control for the Neponset River Basin.

4.3 Reports by the Commonwealth of Massachusetts. The Commonwealth of Massachusetts has made several reports on the Neponset River since 1873, primarily in the interests of sanitation, pollution abatement, and channel dredging and straightening. These reports are on areas too far downstream of the proposed improvement to have any bearing on the flood problem in Canton.

5. DESCRIPTION OF AREA

5.1 Geography. The town of Canton is located in the eastern part of Massachusetts and in the southern part of the "Greater Boston Region" in Norfolk County. Its northern border is Route 128, the circumferential highway around Boston. The Boston-Providence Pike, Route 1, runs in a north-south direction about 3 miles west of

the community of Canton. The East Branch of the Neponset River rises at Forge Pond in the center of the town of Canton at an elevation of 92 feet above mean sea level. The river pursues an erratic northwesterly course for about 2.2 miles, entering the Neponset River at the Norwood-Canton line approximately 6.3 miles south-southwest of Boston. The tributaries of the East Branch are Pequid Brook and Massapoag Brook, both of which flow into Forge Pond, and Redwing Brook and Steep Hill Brook, both of which flow into Bolivar Pond, which in turn drains into Forge Pond. The East Branch Neponset River has a total drainage area of about 31.2 square miles. A map of the Neponset River Watershed is shown on plate 1.

5.2 Topography. The East Branch Neponset River drains an area which is covered with many small lakes and ponds. The hills have gentle grades and rolling topography, and are covered with woods except where the land is in residential or industrial use. There are many small brooks and streams which pass through local swampy areas. The relief varies from about 50 ft., m.s.l., to approximately 250 ft., m.s.l. The East Branch Neponset River and its main tributaries flow through the middle part of the community of Canton. Many small dams have been constructed on the tributaries in the past for various purposes and some of them still remain.

5.3 Geology. Canton, Massachusetts is located in the locally designated Sharon Upland of the Seaboard belt of the New England Physiographic Province. The project improvement is located on the East Branch of the Neponset River, which is a major drainage feature of the Boston Lowland. The topography of the project area consists of smoothly rounded till-mantled hills, through which project rock outcrops of the Quincy Granite formation.

Overburden in the project area will consist primarily of a sandy, glacial till mantle directly on the bedrock surface. Overlying the till are more recent deposits of unconsolidated glacial outwash, alluvium and filled land. Random blocks and boulders will be encountered in the area.

5.4 Maps. The East Branch of the Neponset River and its watershed are shown on standard quadrangle sheets of the U. S. Geological Survey (1:31,680 and 1:62,500) and on standard quadrangle sheets of the Army Map Service (1:25,000).

6. CLIMATOLOGY

6.1 General. The Neponset River Basin has a variable climate characterized by frequent but usually short periods of precipitation. The basin lies in the path of the "prevailing westerlies" and the cyclonic disturbances that cross the country from the west or southwest. It is also exposed to occasional coastal storms, some of tropical origin, that travel up the Atlantic seaboard. In late summer and autumn months these storms occasionally attain hurricane intensity.

6.2 Temperature. Average monthly temperatures in the Neponset River Basin vary widely through the year with a mean annual temperature of approximately 49°F., ranging from about 51°F. at the coast to about 47° in the headwaters. The minimum temperature recorded in the basin was -21°F; the maximum recorded was 101°F. Freezing temperatures recorded each month at Walpole and Blue Hill Observatory, Mass., are shown in Table 1 below. It should be noted that the climate at Walpole is more typical of the upper basin, due to the higher elevation at Blue Hill, but the period of record (9 years) is short.

TABLE 1

MONTHLY TEMPERATURES (Degrees Fahrenheit)

<u>Walpole, Mass.</u>				<u>Blue Hill, Mass.</u>		
<u>Elevation 200 ft., m.s.l.</u>				<u>Elevation 640 ft., m.s.l.</u>		
<u>9 years of record</u>				<u>73 years of record</u>		
<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	28.7	65	-19	25.9	65	-16
February	30.5	70	- 8	25.7	67	-21
March	35.7	77	- 7	34.1	85	- 3
April	47.3	86	10	43.7	89	6
May	56.4	92	24	55.1	93	27
June	65.9	95	34	64.0	99	36
July	71.1	100	40	69.2	99	47
August	68.3	99	37	67.5	101	41
September	60.5	100	26	61.2	99	28
October	52.2	88	22	51.1	87	21
November	42.0	82	8	40.7	81	5
December	31.9	64	-18	29.1	65	-19
Annual	49.2	100	-19	47.3	101	-21

6.3 Precipitation. The mean annual precipitation over the Neponset River watershed is approximately 46 inches, uniformly distributed throughout the year. The maximum and minimum annual precipitations at Walpole for 9 years through 1957 are 57.22 inches and 29.97 inches in 1957. At Blue Hill, the maximum and minimum annual precipitations for 73 years through 1957 are 63.81 inches in 1920 and 32.55 inches in 1941. Table 2 summarizes the precipitation records at Walpole and Blue Hill.

TABLE 2

MONTHLY PRECIPITATION RECORD
(In Inches)

<u>Month</u>	<u>Walpole, Mass.</u>			<u>Blue Hill, Mass.</u>		
	<u>Elevation 200 ft., m.s.l.</u>			<u>Elevation 640 ft., m.s.l.</u>		
	<u>9 years of record</u>			<u>73 years of record</u>		
	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	4.09	7.77	.76	4.09	9.56	.89
February	3.69	4.42	1.84	3.54	8.29	1.04
March	4.49	8.71	1.92	3.87	9.53	.06
April	3.97	6.50	2.83	3.99	8.71	.92
May	3.54	8.11	1.38	3.50	9.16	.50
June	2.07	3.35	.08	4.18	10.78	.53
July	2.06	3.93	.21	3.71	11.82	.13
August	4.65	20.48	.99	4.08	18.78	1.22
September	3.55	8.88	.71	3.77	11.04	.45
October	3.83	7.95	1.70	3.45	8.89	.22
November	5.19	7.90	2.22	4.20	9.29	.63
December	3.56	5.22	.72	3.90	9.01	.92
Annual	44.69	57.22	29.97	46.74	63.81	32.55

6.4 Snow. The mean annual snowfall over the watershed varies from about 43 inches at the coast to 60 inches in the headwater region. Snow cover reaches a maximum depth in late February with the water content in early spring often reaching about 2 inches. Monthly and annual snowfall for 73 years of record at Blue Hill, Mass., are tabulated in Table 3.

TABLE 3

MEAN MONTHLY SNOWFALL AT BLUE HILL, MASSACHUSETTSElevation 640 ft., m.s.l.Average Depth in Inches

<u>Month</u>	<u>Snowfall</u>
January	15.8
February	16.0
March	11.2
April	3.0
May	0
June	0
July	0
August	0
September	0
October	0.1
November	3.1
December	9.9
Annual	58.5

6.5 Storms. The rapidly moving cyclonic storms or "lows" that move into New England from the west or southwest produce frequent periods of unsettled, but not extremely severe weather. The region is also exposed to occasional coastal storms, some of tropical origin, that travel up the Atlantic coast and move over or within striking distance of the New England States. Some of these storms attain hurricane intensity, such as those of September 1938 and August 1955. Hurricane Diane, from August 17 to 20, 1955, produced 13.76 inches of rainfall at Blue Hill and 15.62 inches at Walpole over areas saturated by Hurricane Connie a week before.

7. RUNOFF

7.1 Discharge records. The U. S. Geological Survey has published records of river stages and streamflow on the Neponset River at Norwood, Mass., and on the East Branch of the Neponset at Canton, about 1,000 feet upstream from the proposed dam. The records are good except those for periods of no-gage height record, which are of short period. Streamflow records at the gaging stations are summarized in Table 4. The maximum value at Canton was reduced an estimated 600 c.f.s. by available storage in Reservoir Pond.

TABLE 4
STREAMFLOW RECORDS

<u>Location of Gaging Station</u>	<u>Drainage Area (sq miles)</u>	<u>Period of Record</u>	<u>Discharge (c.f.s.)</u>		
			<u>Mean</u>	<u>Maximum⁽¹⁾</u>	<u>Minimum</u>
East Branch Neponset River at Canton, Mass.	26.7	1952-1957	60.8	1,790	0.5
Neponset River at Norwood, Mass.	35.2	1939-1957	52.3	1,490	2.3

(1) Instantaneous Discharge, August 1955

7.2 Runoff. The annual runoff for the 5 years of record through September 1957 for the gage at Canton varied from 28.41 to 34.62 inches with a mean of 31.82 inches. The annual runoff for the 18 years of record at the Norwood gage varied from 9.05 to 30.46 inches with a mean of 18.69 inches. Table 5 is a summary of the maximum, minimum and mean monthly runoff in inches for the periods of record at Canton and Norwood.

TABLE 5

MONTHLY RUNOFF
(In Inches)

East Branch Neponset River at Canton, Mass. (D.A. = 26.7 sq.mi.)				Neponset River at Norwood, Mass. (D.A. = 35.2 sq.mi.)		
<u>Oct. 1952-Sept. 1957</u>				<u>Oct. 1939-Sept. 1957</u>		
<u>Month</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Mean</u>	<u>Maximum</u>	<u>Minimum</u>
January	3.11	5.11	2.50	2.12	4.10	.41
February	3.29	4.39	2.51	2.20	3.58	.59
March	4.04	5.82	2.91	3.34	5.74	1.63
April	5.05	7.93	2.57	3.02	6.05	1.44
May	2.48	6.14	.96	1.88	4.82	.95
June	1.10	1.59	.77	1.03	2.84	.40
July	.54	.76	.21	.70	2.22	.35
August	2.06	8.78	.16	.82	7.46	.27
September	2.08	3.18	.18	.66	2.81	.25
October	1.62	4.17	.45	1.05	4.16	.29
November	2.72	6.71	.52	1.80	6.01	.37
December	3.15	5.29	1.04	1.79	4.19	.36
Annual	42.19	74.80	28.41	20.38	34.30	9.05

Note: Flows at Norwood are affected by diversion and regulation and may not reflect the true runoff from the drainage area of 35.2 square miles.

8. FLOODS OF RECORD

8.1 Flood causes. Floods on the Neponset River may result from late winter or early spring storms combined with melting snow, such as the floods of February 1886 and March 1936 or from summer or fall storms such as the flood of July 1938 and the record flood of August 1955. In addition, local thunderstorms can cause minor flooding on some of the smaller tributaries. Major floods are rare on the main stream of the Neponset River, as the average elevation of the land is low, the river slopes are not steep; the proportion of the area occupied by swamps, lakes and ponds is high, providing large areas of natural storage. However, on the East Branch, also known as the Canton River, the probability of major flooding is increased at the project site by less natural storage and lower channel capacity.

8.2 Historic floods. The storm of August 1955, resulting in the greatest flood of record on the Neponset River, was caused by heavy rainfall on ground already saturated by rainfall from hurricane Connie occurring during the previous week. The flood of March 1936 was the result of high temperatures and heavy rain on deep snow, as was the flood of February 1886. The flood of July 1938 was the second highest flood of record. Other significant floods occurred in August 1826, October 1869, June 1922 and January 1958.

8.3 Floods of record. Due to the short period of record, the only major flood recorded at either Canton or Norwood was the flood of August 1955, with peaks of 1,790 and 1,490 c.f.s. at the respective stations. The water surface at Reservoir Pond was about 4 feet below normal elevation at the beginning of the storm, affording about 410 acre-feet of storage. There was, therefore, no contribution to the peak from a drainage area of 5.6 square miles; and it is estimated that the peak at Canton was reduced about 600 c.f.s. Minor damage was experienced in January 1958 when a series of storms through the entire month, with a total precipitation of 9.7 inches, filled all the available storage. The maximum discharges at Canton and Norwood were 361 c.f.s., and 384 c.f.s., respectively.

9. FLOOD FREQUENCY

Since the period of streamflow records at the gaging stations on the East Branch at Canton; and the Neponset River at Norwood were too short to develop a reliable statistical analysis, flood frequencies were determined by a regional analysis which included historical data. The regional analysis indicated that the flood of August 1955 as experienced in Canton, Mass., had an annual chance of occurrence of about 0.5 per cent or an exceedence interval of about once in 200 years. The frequency curve as developed for this project area is shown on Plate No. 6.

10. PROJECT DESIGN FLOOD

10.1 Hydraulics of flood problem. The flood problem at the project site is caused by poor channel hydraulics in the East Branch at and below the dam of the Plymouth Rubber Company. This dam has a concrete spillway 63 feet in length and 6.5 feet high with a capacity of about 1,100 c.f.s. The stream bends about 45° to the right 300 feet below the dam and enters three culverts about 400 feet beyond the turn. These culverts, each of which is 4.5 feet square, with a length of 165 feet, have a combined maximum capacity of about 900 c.f.s., thus constituting the control for the channel.

10.2 Standard project flood. A standard project flood was developed for the project area by using the synthetic rainfall from Civil Works Bulletin 52-8 and a unit hydrograph developed from the flood of August 1955. Due to the extensive natural and artificial storage in the basin, it was difficult to obtain reasonable rainfall-runoff relationships. The standard project flood as developed had a peak value of 3,600 c.f.s., which is more than twice the flood of 1,700 c.f.s. experienced in August 1955.

10.3 Design flood. The adopted design flood for the project is 3,000 c.f.s., which is less than the computed standard project flood but is 77% greater than the flood of record. Design for the standard project flood required increased land and property takings that were not considered justifiable. The design flood of 3,000 c.f.s. would provide a high degree of protection. The new channel would divert 2,100 c.f.s., while the remaining 900 c.f.s. would continue to flow in the present channel. If a flood in the magnitude of the standard project flood were to occur, the damages would be limited to overflow from the present channel with a discharge of about 1,100 c.f.s.

11. FLOOD LOSSES

The record flood of the East Branch Neponset River watershed, the flood of August 1955, caused a total loss of about \$2,500,000 in the town of Canton. Hardest hit was the Plymouth Rubber Company plant on the right bank of a small pond located on the East Branch immediately upstream of the Boston-Providence Branch of the New York, New Haven and Hartford Railroad. Approximately 50 houses and 20 commercial firms along Massapoag Brook and around Forge Pond also suffered flood damages. Two dwellings and 14 commercial buildings in the group, as well as all three factories, experienced up to three feet of water at the first-floor level. Ponding of Massapoag Brook behind the Walnut Street bridge caused nearly 7 feet of water to enter the ground floor of a Walnut Street warehouse.

Under conditions prevailing in 1958, a recurrence of the stages produced by the August 1955 flood would cause an estimated loss of about \$2,700,000. Approximately 80 percent of this loss would occur in the Plymouth Rubber Company area.

12. EXISTING CORPS OF ENGINEERS FLOOD CONTROL PROJECTS

There are no existing Corps of Engineers flood control projects in the Neponset River Basin.

13. IMPROVEMENTS BY OTHER FEDERAL AND NON-FEDERAL AGENCIES

13.1 Federal improvements. There are no existing Federal improvements in the basin of the East Branch of the Neponset River.

13.2 State improvements. The Commonwealth of Massachusetts has constructed a concrete dam on Massapoag Brook at the Third Silk Mill Pond and a concrete dam which backs up water to form Forge Pond. A small amount of flood control benefits may accrue from these projects.

13.3 Local improvements. The Plymouth Rubber Company has constructed a concrete overflow dam adjacent to their factory on the East Branch Neponset River for diverting water into the plant for industrial use. Farther downstream on the East Branch Neponset River is a small rock masonry overflow dam. The water impounded by this dam is known as Factory Pond. There are other small dams on various brooks in the Canton area. These dams are of no value for flood control and in some cases they may augment flood losses.

14. IMPROVEMENTS DESIRED

An informal meeting was held at Canton, Massachusetts, on 25 March 1958, for the purpose of discussing studies made by the Corps of Engineers for flood control in Canton. Twenty-three persons were present, including private individuals, the Board of Selectmen and other town officials, and representatives of the State, Corps of Engineers, and private industry.

Representatives of the Corps of Engineers discussed three proposed plans for local protection works in Canton. All those present expressed the need for flood protection. Prints of the preliminary plans were given to State and local interests for further studies.

Several other meetings have been held between representatives of the Corps of Engineers and local interests. The plans for the proposed local protection project have been reviewed by State and Town officials. The Selectmen of the Town of Canton are most desirous of the construction of a flood protection project in Canton.

They have informed the Corps of Engineers that the Town will comply with the local cooperation required by law subject to concurrence by a vote of the Town Meeting. Prints of letters giving the views of local interests are included as inclosures to this report.

15. FLOOD PROBLEMS AND SOLUTIONS CONSIDERED

15.1 Flood problem. The East Branch Neponset River and its principal tributaries flow through the heavily populated areas of Canton and subject them to large destructive floods. In these areas, the channel capacities of the stream are inadequate to contain the flood flows. Streets, bridges, and residential and industrial buildings and lands along the streams are susceptible to damage from overflow. The August 1955 flood caused the largest flood loss of record. The Plymouth Rubber Company received the largest flood loss of any industry in Canton.

15.2 Solutions considered.

a. General. Consideration has been given to all practicable methods of solving the flood problems in the town of Canton. The construction of new reservoirs, alteration to existing dams, channel improvement, dikes, flood walls, and the diversion of floodwaters from areas where heavy damage would occur were considered at various locations in the town.

b. Protection by reservoirs. A study of existing maps and reconnaissances of the streams above the community of Canton showed that there were no dam and reservoir sites where projects could be feasibly developed for flood control. The area is occupied by numerous ponds, reservoirs and swampy areas which provide natural storage for floodwaters which tends to retard and reduce flood peaks. Alterations to existing dams, with a view to providing additional flood storage benefits, was found to be not economically justified.

c. Massapoag Brook Diversion. Massapoag Brook flows through a commercial and thickly populated residential section of the community of Canton. Preliminary studies indicated that the diversion of flood flows of Massapoag Brook away from areas where heavy flood damages had occurred would accrue average annual flood control benefits of about \$41,000, and that the project could be economically justified. Detailed surveys, foundations, investigations, and studies of this proposal were, therefore, made. Plate 2 shows a general plan of this proposed work.

This plan provided for the diversion of flood flows of Massapoag Brook across Washington Street through a channel running in a northerly direction from Washington Street to Neponset Street,

thence to Factory Pond. The greater portion of the area through which the channel would pass is pasture land or land covered with trees. This plan would require the construction of bridges across Washington and Neponset Streets and a private driveway, and the removal of two dwellings. The dam at Third Silk Mill Pond would be altered to provide an uncontrolled spillway in lieu of stoplogs and a closure of a culvert to prevent overflow from the pond flowing into Steep Hill Brook. An inlet and pipeline would be constructed so that the low flows of Massapoag Brook would flow in the present channel.

The preliminary estimated Federal, non-Federal and total first costs for the proposed Massapoag Brook Diversion project are \$290,000, \$190,000 and \$480,000, respectively. The preliminary estimated annual flood control benefits, annual charges, and benefit-cost ratio are \$41,000, \$18,000, and 2.3 to 1.0, respectively.

d. Joint plan diversion. Plate 2 shows a general layout for the joint plan of diverting flood flows of the East Branch Neponset River and Massapoag Brook. This proposal is a combination of the recommended improvement discussed in following Section 16 and the proposal discussed in preceding paragraph 15-2c. However, because part of the flood flows tributary to the East Branch Neponset River would be diverted by the proposed diversion of Massapoag Brook, the East Branch Neponset River Diversion dam and channel would be smaller than if this project were constructed alone as proposed in the recommended plan. The project design floods for the Massapoag Brook and East Branch Neponset River are 1,000 c.f.s and 2,000 c.f.s., respectively.

The preliminary estimated Federal, non-Federal, and total first costs for construction of the joint plan are \$400,000, \$230,000 and \$630,000, respectively. The estimated annual charges, annual flood control benefits, and the benefit-cost ratio are \$24,000, \$49,000, and 2.0 to 1.0, respectively.

This data indicates that the joint plan would be an economically feasible project, but it would have a lower benefit-cost ratio than the recommended project. The Board of Selectmen of the Town of Canton requested that the preliminary studies for the joint plan be continued, but later, as a result of their studies and discussions, requested that the scope of the local protection project in Canton be limited to the diversion of the East Branch Neponset River around the Plymouth Rubber Company plant. The joint plan was, therefore, not selected for construction.

16. PROPOSED IMPROVEMENT

16.1 General description. Plate 2 shows a general layout of the recommended plan for local flood protection in Canton, Mass. The project would provide for the diversion of flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant. It would include the construction of a concrete overflow dam about 156 feet long, located adjacent to the existing Plymouth Rubber Company dam, a diversion channel below the dam about 1,600 feet long, with a bottom width of 60 feet.

The low banks along the channel would be filled or diked to the minimum protection elevation which is three feet higher than the calculated water surface elevation in the channel, based on a design flow of 2,100 c.f.s. The channel banks, where they are of earth, would be protected with rock riprap obtained from rock excavation for the channel. A 6-inch course of gravel would be placed on top of the dikes, making them suitable to carry traffic for maintenance purposes. Top soiling and seeding would be accomplished in filled areas and in cut areas above the proposed dam. An approach channel to the diversion dam would be provided. Plates 4 and 5 show a plan, profiles and sections for the recommended plan of improvement.

16.2 Bridges. There are no bridges included in the proposed project. The Plymouth Rubber Company has indicated that they may, in the future, construct a bridge across the diversion channel. They have been told that the clearance elevations and dimensions for the bridge must be approved by the Corps of Engineers before the bridge is constructed.

16.3 Utility relocations. Local interests would be required to relocate and alter the utilities which would affect the work or be affected by it. Such work would include the lowering of a 6-inch water line, the raising of five Metropolitan District Commission sanitary sewer manholes, the extension of an 8-inch vitrified clay sanitary sewer line and connection of the line to the Metropolitan District Commission sanitary sewer, and the relocation of a chain link fence.

16.4 Hydraulic design.

a. Weir. The selected crest of the new weir for the diversion channel is elevation 80.3 m.s.l., which is 0.2 feet above the existing weir. The small difference in crests will insure that low discharges will flow in the existing channel. The safe channel capacity of 900 c.f.s. in the present channel through the Plymouth Rubber Company is produced with a head of 2.7 feet on the present dam. With a head of 2.5 feet on the diversion dam, a crest length

of over 150 feet is required to divert 2,100 c.f.s., assuming a discharge coefficient of 3.5. The curved spillway layout has a total length of 156 feet to take advantage of rock on the left abutment.

b. Diversion channel. Several trials were required to obtain a trapezoidal channel that would maintain subcritical velocities. The final selected channel has a bottom width of 60 feet with side slopes of 1 on 2. The channel slope for the first 1,050 feet is .0060, while the remaining 500 feet to Factory Pond has a slope of .0087.

c. Water surface elevations. The design water surface profile as shown on Plate No. 5 was developed by backwater computation, using Manning's Formula as outlined in Engineering Manual for Civil Works Construction, Part CXIV, Chapter 9. The starting elevation for 68.0 m.s.l. at Factory Pond was determined from an extrapolated rating curve. It represents a water surface about 2 feet higher than experienced in August 1955. Using a coefficient of roughness "17" of 0.035, the computed water surface represented depths of water between 3.7 and 4.7 feet, with corresponding average velocities between 6 and 9 feet per second.

d. Freeboard. The design grade of all walls and dike were set at an elevation three feet above the computed water surface profile. Computations for superlevation on the curves indicated that the rise in water surface would be less than 0.4 feet and therefore was not considered in the design grades.

16.5 Surficial and subsurface investigations.

a. General. In 1957 and 1958, 8 test borings and 6 shallow hand-auger borings were made for the recommended local protection project adjacent to the Plymouth Rubber Company. Plate 3 is a plan and record of these foundation investigations.

Other studies and investigations included a geological reconnaissance of the area, a review of applicable record drawings for the new Neponset Valley Sewer constructed by the Metropolitan District Commission and of boring logs made for a warehouse which is being constructed by the Plymouth Rubber Company adjacent to the downstream end of the diversion channel.

b. Channel excavations and slopes. The diversion channel excavations will be made in highly variable overburden and in bedrock. Earth excavations from approximately Sta. 3+00 to 10+00 will be made generally in silty, gravelly sand and silty, sandy gravel having the characteristics of glacial till as the bedrock surface is neared. Upstream of Sta. 3+00, the earth excavations are expected

to consist of silty, gravelly sand and soft organic material adjacent to and within the stream channel. Downstream of Sta. 10+00, the excavations will be made in variable deposits of gravel, sand, and silt overlain by 2 to 6 feet of soft organic swamp deposits occupying the low-lying areas.

Subsurface water level is near the ground surface in the lower elevations downstream of Sta. 10+00. The high subsurface water level and the silt and sand deposits of variable thicknesses will require careful control of excavation operations to retain the design slopes during construction. The bedrock observed at the site and recovered from core borings in the vicinity of the Plymouth Rubber Company dam consists of a hard, gray to pink granite which is extensively weathered along frequent joint surfaces to depths of about 15 feet. Weathering along joint planes and loss of water during drilling indicate an open joint condition which will govern the rock breakage characteristics during excavation.

Rock excavation for the diversion channel will be required in the vicinity of the weir as indicated by borings and outcrops in this area. No bedrock excavation is expected downstream of about Sta. 9+00 along the diversion channel. However, rock is at shallow depths throughout much of the area and in view of the highly irregular nature of the bedrock surface, it is possible that limited quantities of rock may be encountered in the downstream portion of the diversion channel.

Channel side slopes excavated in earth are to be 1 on 2 and the slopes immediately upstream and downstream from the spillway will be set back, providing a 5-foot berm at the top of the rock cut. Channel side slopes in rock are planned to be 4 on 1.

The proposed channel excavation may cause lowering of the subsurface water level in the vicinity of the work. Local interests were informed that they would be required to hold and save the United States free from damages due to the construction works regarding this and all other matters pertaining to the work. The Superintendent of Public Works, Canton, Massachusetts, stated that all dwellings near the proposed project were connected to the town water supply and sanitary systems and that he knew of no utilities which would be adversely affected by the proposed construction.

c. Dikes. Earth-fill dikes are to be constructed on the right side of the channel in the low areas downstream from the spillway. The dikes will have a top width of 10 feet and will attain a maximum height of about 7 feet with side slopes of 1 on 2. The channel side of the dike will be protected against erosion by a 2-foot layer of rockfill.

The foundation material for the dikes consists of sand, sandy gravel, and silt strata of varying thicknesses overlain by a variable thickness of soft organic swamp deposits having an average depth of about 3 feet with greater depths in limited areas. Except for the soft organic material that is to be removed, the shear strength of the dike foundation materials along the channel alignment is considered adequate to support the loads produced by the low dikes. Stripping of the soft organic material will also be required for a width of 12 feet from the channel bank in areas which are to be filled adjacent to the channel.

Materials for dike construction and for filling low areas to a width of 12 feet from the edge of the new channel will be obtained from the required earth excavation and will consist principally of gravelly, silty sand and silty, sandy gravel. From an examination of the grain size curves, it is estimated that the coefficients of permeability of this material will be in the range of 1×10^{-4} cm/sec. In view of the limited height of the dike, the embankment and foundation material are considered adequate for stability and for the control of seepage. Materials unsuitable for dike construction will be utilized to fill low areas and for topsoiling.

d. Slope protection. Slope protection, for both the channel side of the dikes and the excavated earth slopes downstream from the spillway, will be provided by a 2-foot layer of quarry-run rockfill. The quality of rock available from the required excavations will be satisfactory to meet the requirements for channel protection; however, some of the rock may require secondary blasting. The estimated water velocity in the channel is about 9 ft./sec., which requires a rockfill thickness of 1 foot over 6 inches of gravel for adequate slope protection, according to current Corps of Engineers criteria. However, since a sufficient quantity of rock will be available from the required excavations and the natural foundation materials are relatively well graded up through gravel sizes, the six inches of gravel bedding was omitted and a 2-foot thick rockfill layer was established which will allow use of rock up to 18-inch size and thereby reduce the amount of required secondary blasting.

e. Spoil area slopes. The spoil areas adjacent to the diversion channel will be protected by four inches of seeded topsoil. The spoil area at the downstream end of the diversion channel will be graded around the existing building and will not have slopes greater than 1 on 3. Local interests need fill in an area proposed for a new schoolhouse about one mile from the site of the work and will make this area available for spoil from excavation if it is needed. The contractor will be permitted to obtain his own spoil area.

f. Foundation for concrete structures. Consideration has been given, in the design of the project structures, to available geologic information. Geologic conditions appear generally favorable for the construction of the proposed concrete structures.

The weir extension and training walls at the existing Plymouth Rubber Company dam will be founded in granite which will require only moderate rock excavation to provide a surface suitable for concrete placement. Weathered joint surfaces may require cleaning and dental treatment to remove local pockets of weathered material. Rock excavation adjacent to the existing concrete dam and the Metropolitan District Commission sewer line should be performed by drilling and broaching to prevent damage to the existing structures. Water loss during drilling indicates that it will be necessary to provide a water-tight cutoff beneath the structure to a depth of 70% of the existing hydrostatic head. This provision has been included in the estimate of cost for the work.

Line drilling for structure excavations will be effective in preventing excessive overbreak. However, some unavoidable overbreak will occur in local areas due to the prevailing joint condition and pattern.

In view of industrial buildings, sanitary sewer, concrete structures and homes immediately adjacent to areas of rock excavation, regulatory controls will be provided for in the specifications in order to prevent blast damage to existing structures.

The small gate structure at the mouth of the canal diverting processing water to the Plymouth Rubber Company will be founded on rock which exists at a depth of approximately four feet below the bottom of the stream channel. The single boring at this structure location indicates that two to five feet of weathered rock will be removed to provide a suitable surface for the concrete footings.

17. STRUCTURAL DESIGN

17.1 Purpose. This section of the design memorandum presents the design criteria, basic data and assumptions used in the structural design of the Spillway Weir Gravity Type Walls, Channel Lining and Intake Structure. A brief description of the loading conditions and assumptions used is included to show the design procedure. Typical computations are included in the Appendix, showing the maximum conditions of loading.

17.2 Scope. The structural design, including stability investigations, is outlined herein.

17.3 Design criteria.

a. General. All allowable working stresses conform to those specified in the Engineering Manual EM 1110-1-2101, "Working Stresses for Structural Design," dated 6 January 1958. Loading conditions, design assumptions and other design criteria are based on the following applicable parts in the Engineering Manual for Civil Works issued by the Office of the Chief of Engineers; Standard Practice for Concrete, Part CXX, October 1953; Gravity Dam Design (Part CXXII, October 1952); Structural Design of Spillway and Outlet Works (Part CXXIV, December 1952); Retaining Walls, issued as Part X, Chapter 9, dated July 1945. Accepted engineering practice has been employed in cases where the Engineering Manual for Civil Works does not apply.

b. Concrete. The following table lists the concrete and reinforced concrete stresses used in the design of these structures. In each case, the Civil Works Manual exposure classification A (applicable to structures subject to moderately severe weather exposure) has been used.

<u>Flexure</u>	<u>Lbs. per Sq. In.</u>
Extreme fiber stresses in compression	1,050
Extreme fiber stresses in tension (plain concrete)	60
<u>Shear (v)</u>	90
<u>Bond (u) Deformed bars</u>	
Top bars	210
All others	300
<u>Modular ratio (n)</u>	10

c. Reinforcement.

(1) Grade and working stresses. All reinforcement in the walls, including temperature and shrinkage reinforcement, is designed for the working stresses of new billet steel, intermediate grade, deformed bars, which is 20,000 p.s.i. in flexural tension. The reinforcement shall conform to the requirements of Federal Specification QQ-S-632 Type II, Grade C and to ASTM A-305-56T.

(2) Minimum cover for main reinforcement.

All cases 4 inches

The concrete cover for spacer rods and similar secondary reinforcement may be reduced by the diameter of such rods.

(3) Splices. All splices will be lapped 30 diameters to develop by bond the total working strength of the bars.

(4) Temperature and shrinkage reinforcement. Temperature and shrinkage reinforcement will be provided in slabs or walls where the main reinforcement extends in only one direction. Such reinforcement will provide for a ratio of steel area to concrete area (bd) of 0.002.

17.4 Basic data and assumptions.

a. Controlling elevations (m.s.l.)

Top of spillway crest elevation	80.3
Maximum water surface just upstream at spillway weir	82.8
Maximum tailwater elevation	78.0

b. Loads.

(1) Dead Loads. The following unit weights for material have been used:

<u>Material</u>	<u>Dry</u>	<u>Unit Weight (lbs/cu.ft.)</u>		
		<u>Saturated</u>	<u>Moist</u>	<u>Submerged</u>
Random fill	120	135	125	73
Concrete (plain and reinforced)	150			

c. External water pressure. In cases where hydrostatic pressure affects the design of a structure, it has been assumed to act over the entire area in question under the full head available.

d. Earth pressure. Earth pressure used against the structure has been determined in general in accordance with Part X, Structural Design, Chapter 9, Retaining Walls.

e. Earthquake forces. Earthquake forces are considered negligible and are not included in the design.

f. Ice pressure. Horizontal forces due to the expansion of ice have been disregarded.

g. Wind pressure. Wind pressure on the wall is negligible and has been disregarded in the design.

h. Location of resultant. In the investigation for stability of the walls and spillway, the resultant of the horizontal and vertical loads has in general been held within the middle third.

i. Factor of safety sliding. A factor of safety against sliding of at least 1.5 has been obtained.

j. Soil bearing pressure. Maximum soil bearing pressure under structures founded on earth have been held to 2,000 lbs per sq. ft.

k. Frost cover. On the basis of temperature records at Canton, Mass., a minimum frost protective cover of 4'-0 feet above foundation level has been used for any structure founded on earth.

17.5 Spillway weir.

a. Description. The spillway weir is a curved concrete ogee shaped section cut out of rock. On both abutments it terminates against a short section of concrete lining anchored to rock. On the right abutment the concrete lining is joined by a short section of gravity wall upstream of the weir that also ties into the existing concrete dam.

b. Stability analysis. The following loading conditions were investigated as governing the design of the spillway section:

Case I. Construction condition, pool dry.

Case II. Operating condition, pool to spillway crest with full uplift varying from full head upstream to zero at the toe.

Case III. Not critical

Case IV. Maximum flood condition, reservoir to maximum surcharge elevation of 82.8 and tailwater at elevation 78.0. Full uplift varying from full headwater to full tailwater at the toe.

c. Designed section. It was found that under Case IV loading, which was most critical, that the resultant fell at approximately the third point of the base. The sliding friction value of the concrete on the rock was found to be only .56 which is considered well within allowable limits. The short section of lining extending

from the toe of the weir to the bottom of the channel is of minimum thickness and will be anchored to the rock with No. 8 anchors spaced 6'-0" center to center. Minimum reinforcing of #6 bars spaced 1'-0" center to center each way will be placed in the concrete lining. Vertical contraction joints will be spaced at 30-ft. intervals in the weir and lining.

d. Spillway channel lining. The spillway channel lining on each side will be 1'-0" thick anchored to the rock with #8 anchors spaced 6'-0" center to center and reinforced with #6 reinforcing bars spaced 1'-0" center to center. Thickness of concrete, size of anchors and reinforcing steel are of minimum dimension as the head of water possible behind the lining is negligible. Where top of lining is slightly above existing rock surface, a small gravity section will be used with a front slope of 1 to 4 and a back slope of 1 to 3.

e. Intake structure. A small intake structure controls the flow into the cooling water canal of the Plymouth Rubber Company. The structure contains a manually operated gate for a 24" cast iron pipe and has a small trash rack to catch debris. Stability computations are included in the Appendix.

f. Gravity walls. Short stretches of gravity wall tie the intake structure into the right bank and the abutment of the existing dam. The gravity wall is founded on rock and has been investigated for stability with water to spillway surcharge level and fill on backside at the existing channel bottom. The resultant of the horizontal and vertical forces falls within the middle third of the base and the friction value of the concrete on the rock was found to be 0.39.

18. MULTIPLE-PURPOSE FEATURES

The proposed local protection project in Canton, Massachusetts would be solely for flood protection and it will contain no multiple-purpose features.

19. RECREATIONAL DEVELOPMENT

The project would not be suitable for recreational uses.

20. ESTIMATES OF FIRST COST AND ANNUAL CHARGES

Estimates of Federal and non-Federal first costs and annual charges are given in Table 6. These estimates have been prepared on the basis that local interests would bear the entire cost of relocations and alterations to utilities; furnish all lands and rights-of-way necessary for construction and operation of the project, including

disposal areas for excavated materials not used in the dikes, and operate and maintain the project after completion.

Unit prices used in estimating costs are based on average bid prices for similar work in the same general area. The adopted unit prices are adjusted to the 1959 price level and include minor items of work which do not appear in the cost estimates. Annual charges are based on an annual interest rate of 2.5 percent, with amortization of the project cost distributed over a 50-year period. A summary of first costs and annual charges are given in Table 6 following:

TABLE 6
EAST BRANCH NEPONSET RIVER
COST ESTIMATE FOR LOCAL PROTECTIVE WORKS

		FIRST COST (1959 Base)		
<u>FEDERAL</u>				
<u>Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Cost</u>	<u>Amount</u>
Site preparation	1	Job	L.S.	\$ 1,000
Clearing	1	Job	L.S.	1,000
Stream control	1	Job	L.S.	5,000
Stripping	10,000	c.y.	\$1.00	10,000
Common excavation	17,000	c.y.	1.00	17,000
Rock excavation	9,600	c.y.	5.00	48,000
Placing and shaping embankment	12,000	c.y.	.20	2,400
Placing and shaping rockfill	6,000	c.y.	2.00	12,000
Gravel	300	c.y.	3.00	900
Concrete	580	c.y.	50.00	29,000
Cement	870	bbl.	6.50	5,655
Topsoil and seeding	14,000	s.y.	0.30	4,200
Gate valve and pipe at intake	1	Job	L.S.	2,600
Trash rack and frame	1,800	Lbs.	0.50	900
Remove abutment at existing dam	1	Job	L.S.	500
Reinforcing steel	6,000	Lbs.	0.15	900
Grouting curtain for dam	1	Job	L.S.	2,000
Line drilling	450	s.f.	3.00	1,350
Anchor bars	50	ea.	20.00	1,000
Drainage	1	Job	L.S.	1,000
Subtotal				146,405 ✓
Contingencies @ 15% +				21,595
Contract Price				168,000
Engineering and design				34,000
Supervision and administration				16,000
Total Estimated Federal First Cost				\$218,000 ✓

NON-FEDERAL

<u>Item</u>	<u>Amount</u>
Connect 8" sewer to Metropolitan District	
Commission sanitary sewer	\$ 2,600
Lower 6" cast iron water line	1,000
Raise existing manholes	1,000
Lands and damages	10,000
Extend 36" R.C.P. culvert	1,500
Relocate chain link fence	900
	<hr/>
Total Estimated Non-Federal First Cost	\$ 17,000
Total Estimated Project First Cost	\$235,000

ANNUAL CHARGESFEDERAL

Interest (2.5% x \$218,000)	\$ 5,450
Amortization (1.026% x \$218,000)	<u>2,250</u>
Total	7,700

NON-FEDERAL

*Interest (2.5% x \$17,000)	\$ 425
Amortization (1.026% x \$17,000)	175
Maintenance	500
Loss of taxes	<u>200</u>
Total	\$ 1,300

*Because of the small non-Federal costs, the Annual Charges for land were not estimated separately.

Total Annual Charges	\$ 9,000
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$$\text{Benefit-Cost Ratio} = \frac{\$44,000}{9,000} = 4.9 \text{ to } 1.0$$

21. ANNUAL BENEFITS

The Plymouth Rubber Company, which is vital to the economic life of Canton, suffered one of the major individual flood losses in hard hit southern New England from the August 1955 flood. The dike and diversion project, by keeping floodwaters out of this property, would prevent more than \$2-1/3 million of losses in a recurrence of the August 1955 flood, or about 90 percent of the recurring loss on the East Branch. If this were the only flood to occur in a 200-year statistical period, which is the frequency assigned to it (Par. 9), the benefits would be nearly \$12,000. But it is obvious that statistically more frequent floods cause losses in this property and, therefore, that the benefits from protection are greater than this.

Damage-frequency, translated to an average annual loss of \$44,000 at 1958 prices for the Plymouth Rubber Company, was determined by correlation of discharge-recurring damage and discharge-frequency relationships as shown in Plate No. 6. The curve of damage-frequency was cut off at 0.1 percent chance of occurrence in a single year, since available data would not support further extrapolation.

The dike and diversion project would eliminate losses from all floods more frequent than once in 1000 years or those with greater than 0.1 percent chance of occurrence in a single year. Therefore, the flood damage prevention benefit is taken to be \$44,000.

The diversion channel would indirectly produce additional monetary benefits, although these have not been evaluated. As stated in Exhibits 1 and 1A, the diversion would permit greater releases from Forge Pond during floods, thereby reducing flood losses around the Pond and along the lower reaches of tributary brooks.

Because of the high use existing in the protection area and the lack of evidence to suggest that floods are inhibiting this use, no enhancement benefits have been assigned to the project.

22. SCHEDULES FOR DESIGN AND CONSTRUCTION

22.1 Design. It is estimated that the preparation of contract plans and specifications for the project will require three months. The estimated cost of plans and specifications is \$10,000.

22.2 Construction. Construction of the project would be accomplished under a single contract to be awarded in the late summer or early fall of 1959. The work could be completed in five months and in one season, except for the minor seeding work which

might have to be accomplished in the spring of 1960. All funds for the design and construction of the project should be made available prior to award of the contract to permit completion of this urgently needed project in the current construction season. Expenditures are estimated as follows:

Allotments to date	\$ 24,058
Preparations of plans and specifications	<u>10,000</u>
Total estimated expenditures by end of FY 1959	34,058
Construction FY 1960	<u>183,942</u>
Total	\$218,000

23. OPERATION AND MAINTENANCE

Maintenance of the project will be the responsibility of local interests. Periodic inspections will be made to assure that adequate maintenance is performed in accordance with regulations prescribed by the Secretary of the Army. Local interests will be informed that before any bridge is constructed across the diversion channel, the waterway area and the minimum clearance area will have to be approved by the Corps of Engineers. The estimated maintenance cost, to be borne by local interests, is \$500 annually.

24. LOCAL COOPERATION

In accordance with Section 3 of the Flood Control Act of 1936, local interests would be required to provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction and operation of the project; hold and save the United States free from damages due to the construction work; and maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army. Local interests would also be required to furnish disposal areas needed for the work, make all relocations and alterations to utilities and roads required because of the work.

Pursuant to provisions of Public Law 685, local interests would be required to contribute to the United States all cost it incurred for the work in excess of the statutory limitations of \$400,000.

Because the Chief of Engineers has the authority to require local cooperation which deviates from the general policy, if conditions warrant, consideration has been given to this matter. The proposed

local protection project would divert the flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant and thereby give flood protection primarily to one industry. The effect that this protection would afford to the town of Canton was therefore investigated.

Exhibits 1 and 1A of this report are copies of letters from the Town of Canton and the Plymouth Rubber Company, presenting information for the purpose of showing the importance of the recommended flood protection project to the town. A summary of the information they present follows:

a. The Plymouth Rubber Company is the largest single employer in Canton and it has a major effect on the town's economy through its payroll, local purchases of materials and services and by the consumption of goods purchased in the town by its employees.

b. The recommended project would eliminate flooding of the Plymouth Rubber Company plant and thereby permit, when necessary, the opening of the gates of the Forge Pond Dam, located above Washington Street. This procedure would lower Forge Pond and reduce flooding in areas adjacent to this body of water.

Two other plans for diverting flood flows in Canton were considered. They are discussed in preceding paragraphs 15.2c. and 15.2d.

Town officials and many private citizens of Canton have indicated a strong desire for the construction of a local flood protection project in Canton. The Selectmen of the Town of Canton have stated that they are desirous of the construction of a flood control project in their town and, subject to a vote of the Town Meeting, will comply with the local cooperation required by law, as outlined in the first part of this Section, for the recommended plan of diverting flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant.

On March 16, 1959, the Town of Canton voted to comply with the local cooperation required by the Flood Control Act of 1936 and Public Law 685 as set forth in this report for the recommended local protection project. Also, the Board of Directors of the Plymouth Rubber Company voted on January 14, 1959 to authorize and empower the President of said company to make an agreement with the Town of Canton and the Government of the United States for whatever he deems proper and desirable regarding the conveyance of lands, easements, and rights-of-way owned by said company which are necessary for the construction of the project. Exhibits 4A and 12 through 13B are relative to these matters.

25. COORDINATION WITH OTHER AGENCIES

Plans for the proposed local protective works in Canton have been reviewed by the Metropolitan District Commission, Boston, Mass., the Department of Public Works, Commonwealth of Massachusetts, the Town of Canton, the U. S. Bureau of Public Roads, U. S. Soil Conservation Service, U. S. Department of Health, Education and Welfare, and the U. S. Department of Fish and Wildlife Service. The project would have no effect on Federal, State, or town highways, recreation, fish and wildlife, pollution abatement, or other collateral purposes. Copies of comments from the above agencies are included as exhibits to this report.

26. CONCLUSIONS

Investigations and studies covered by this report lead to the following conclusions:

a. A local protection project for the diversion of flood flows of Massapoag Brook from areas where heavy flood damage would occur would have a benefit-cost ratio greater than unity. This project was not recommended, however, because a more feasible one could be provided and because it was not favored as a single project by local interests.

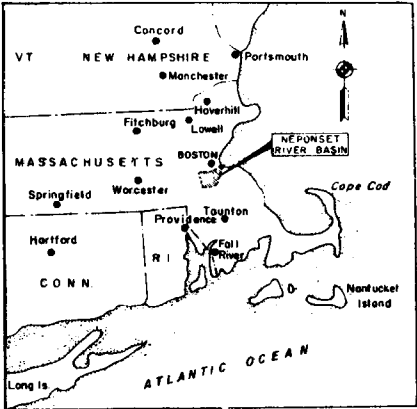
b. A local protection project for the diversion of flood flows of Massapoag Brook and the East Branch Neponset River from areas where heavy damage would occur could be economically justified. Local interests like the flood control features of this project because of the protection it would afford to a large number of commercial and residential properties. However, because of the large local costs involved, local interests are unable to provide the local cooperation required for this project.

c. The construction of a local protection project for the diversion of flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant is economically justified. Even though the direct benefits accruing from this project would result primarily from flood protection afforded to the Plymouth Rubber Company, the indirect benefits to the Town of Canton would be large because the Plymouth Rubber Company is a major factor in the economy of the town.

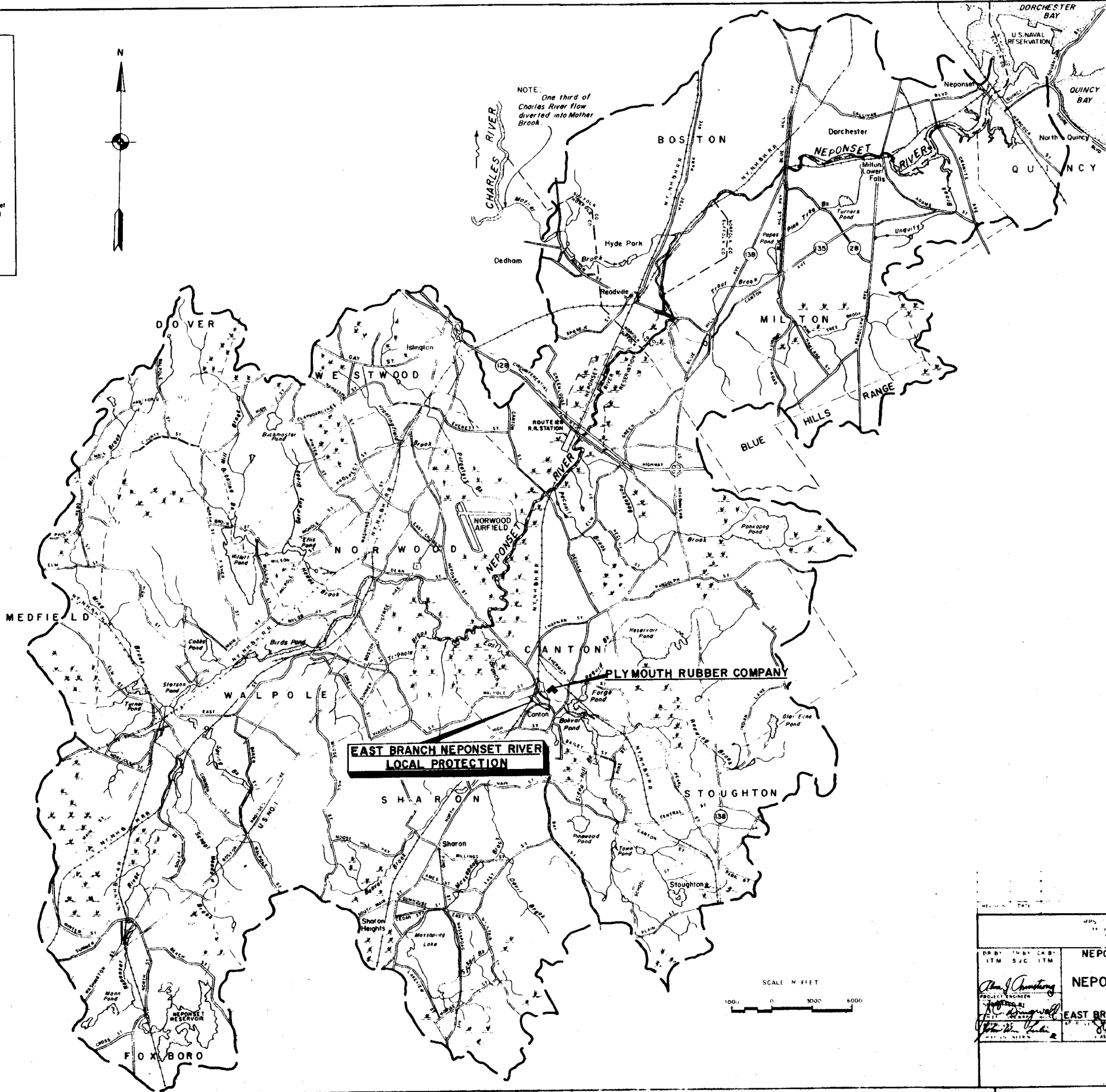
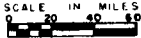
d. Local interests desire the local protection project recommended for construction and they are willing and able to meet the required local cooperation.

27. RECOMMENDATIONS

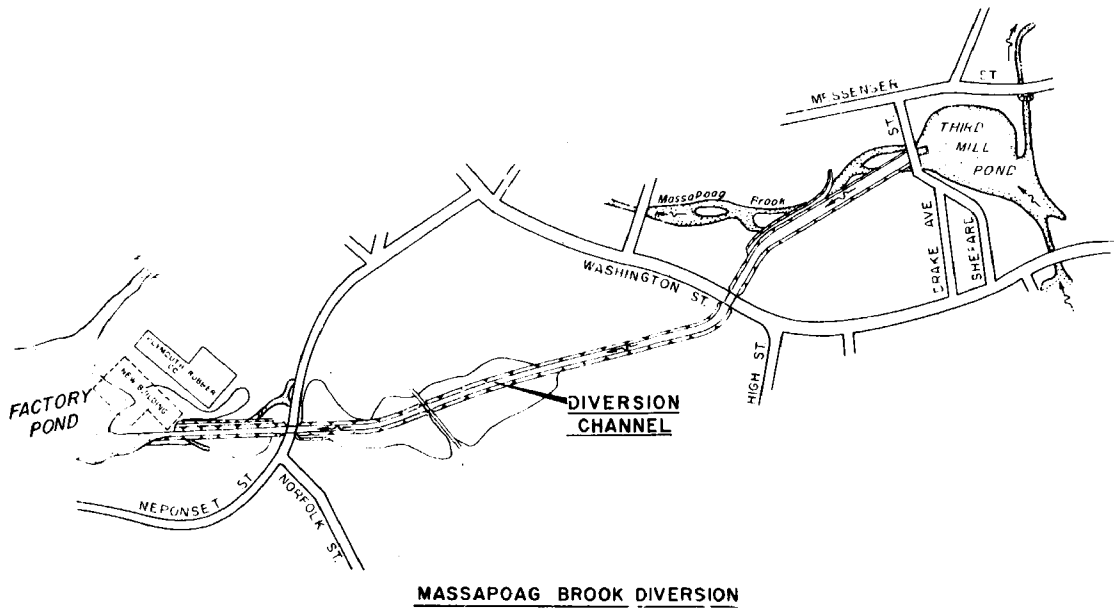
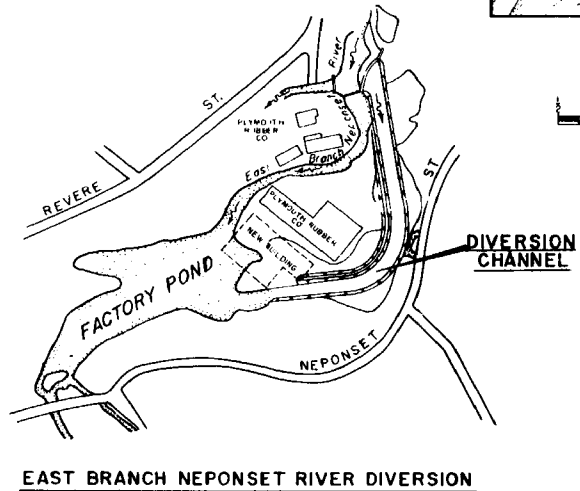
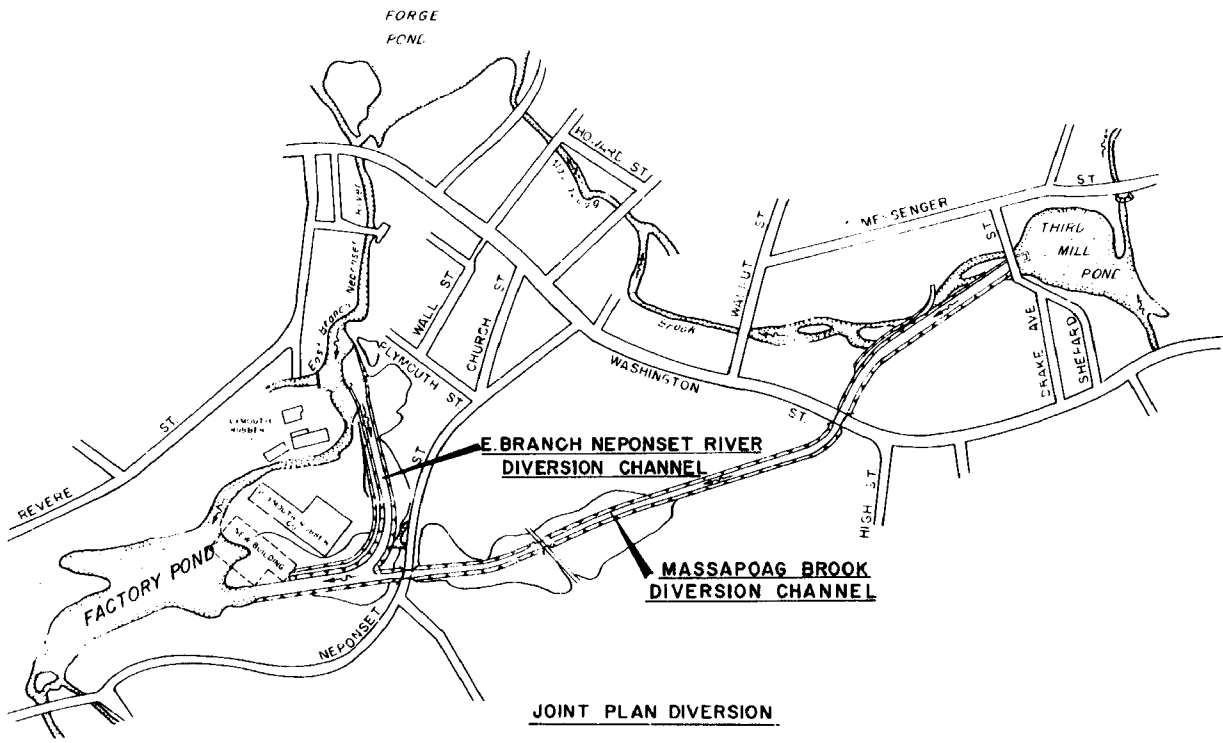
It is recommended that the project, as submitted in this report, be authorized by the Chief of Engineers under the provisions of the Flood Control Act of 1948, as amended, and that additional funds be allotted in the amount of \$10,000 for planning and \$184,000 for construction.



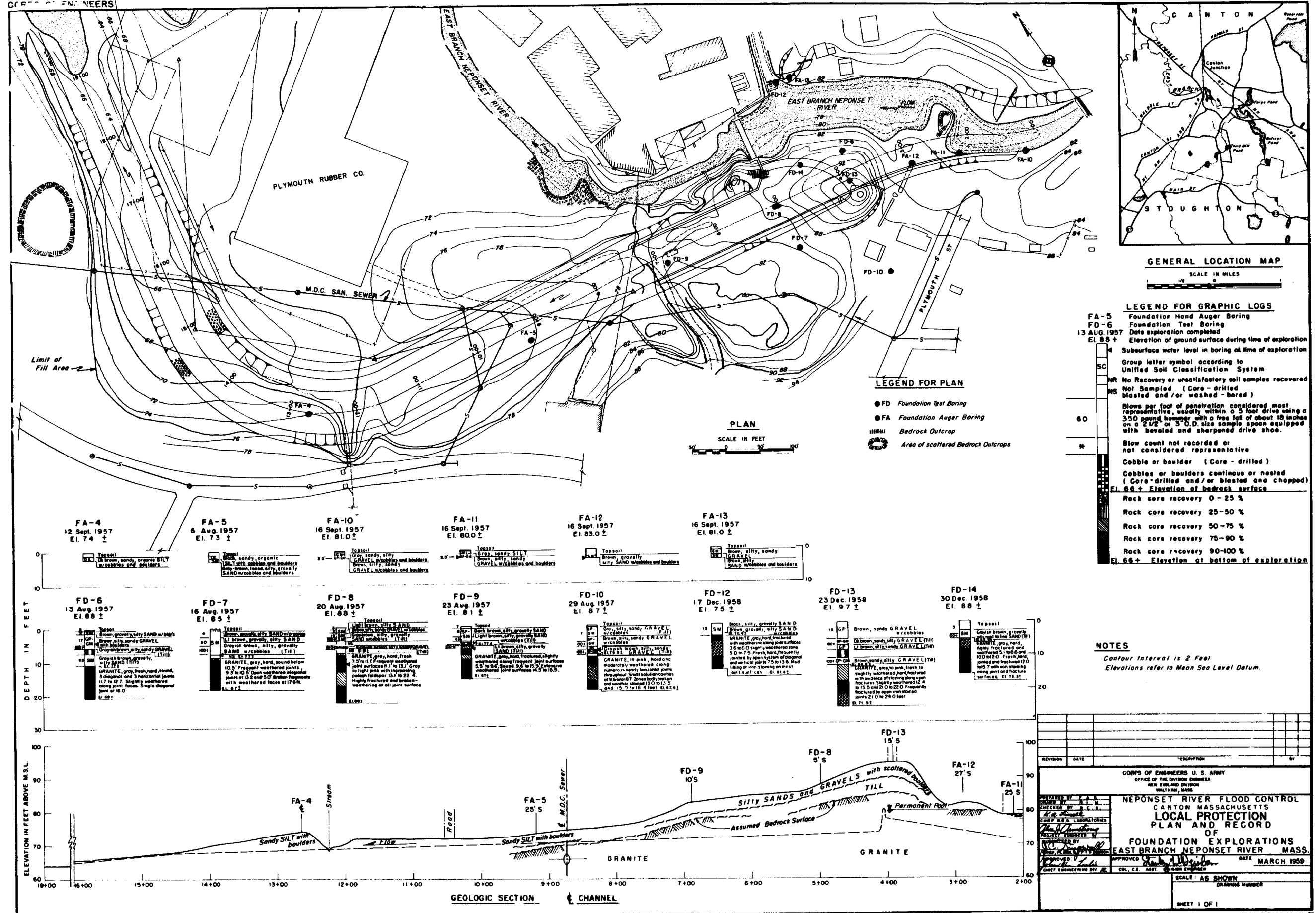
LOCATION MAP

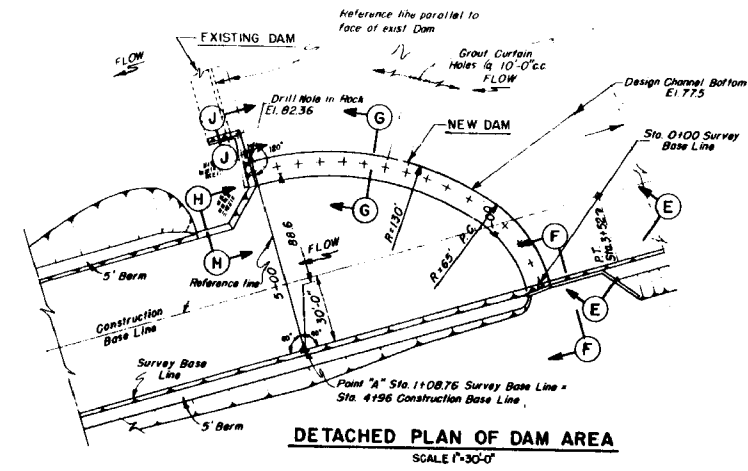
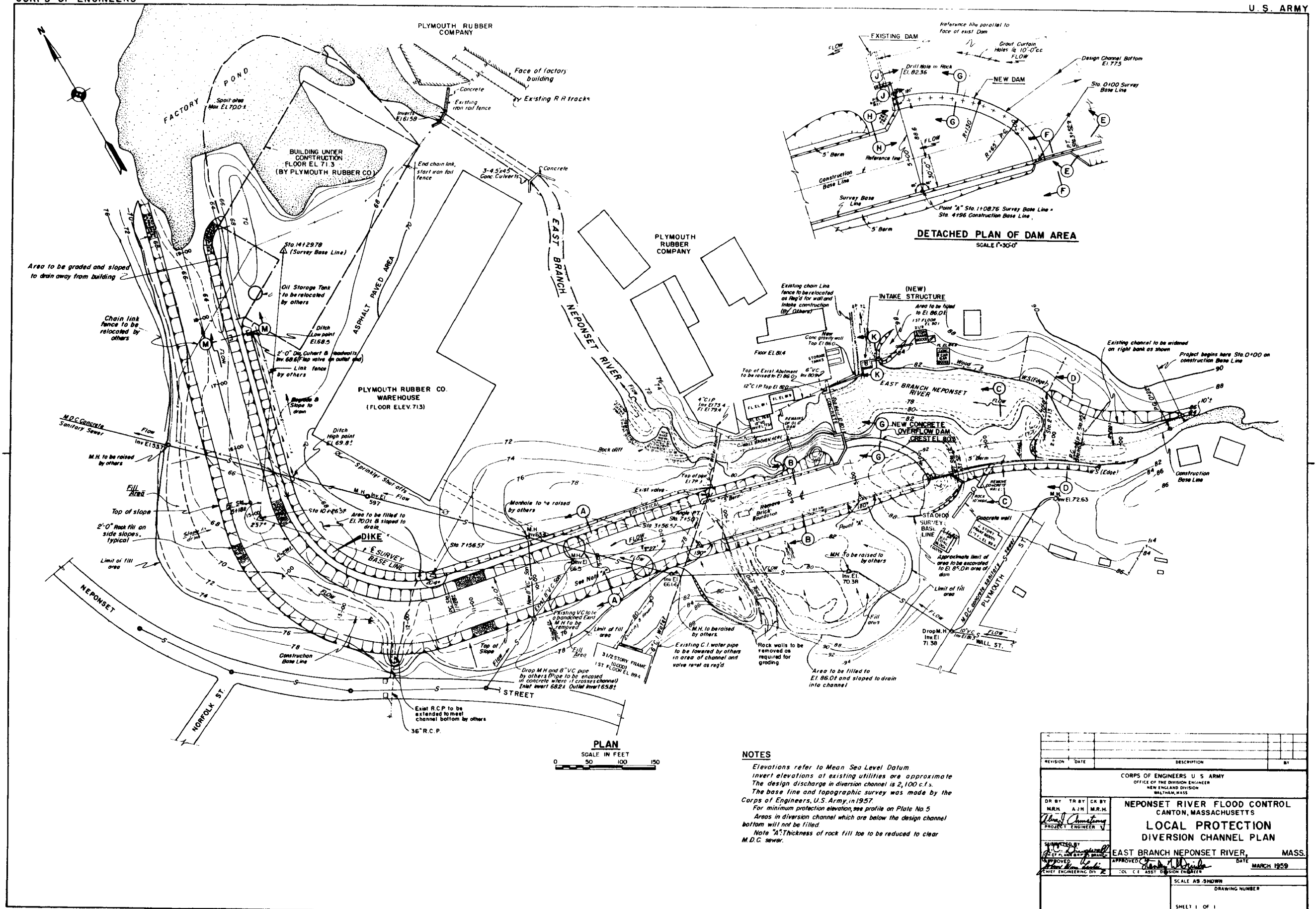


U.S. ENGINEERS U.S. ARMY WALTHAM, MASS.	
NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS	
NEPONSET RIVER WATERSHED	
DR BY: 1001 CAB 11M SJC 11M	PROJECT ENGINEER: <i>Stanley W. Decker</i>
EAST BRANCH NEPONSET RIVER, MASS.	
DATE: MARCH 1939	
SHEET NO. 1	

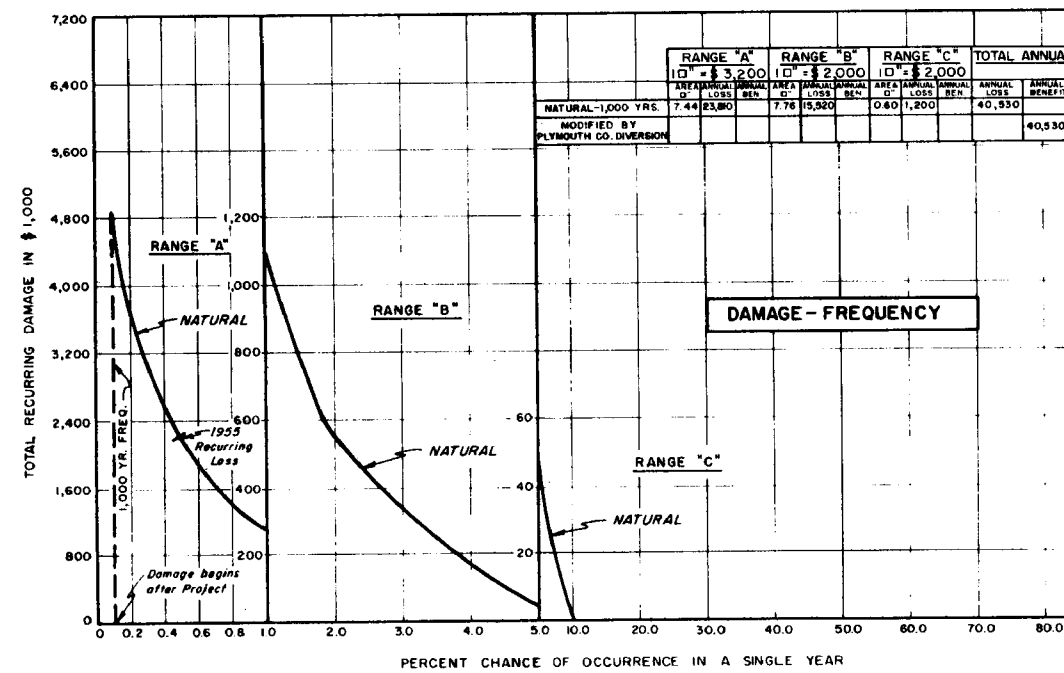
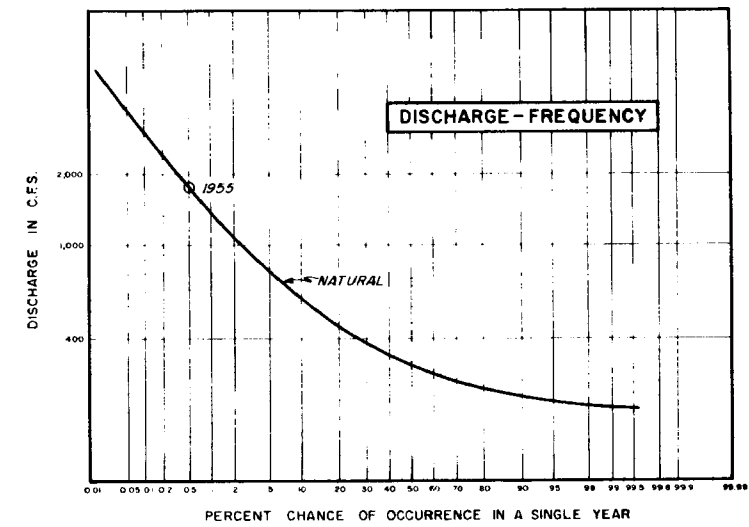
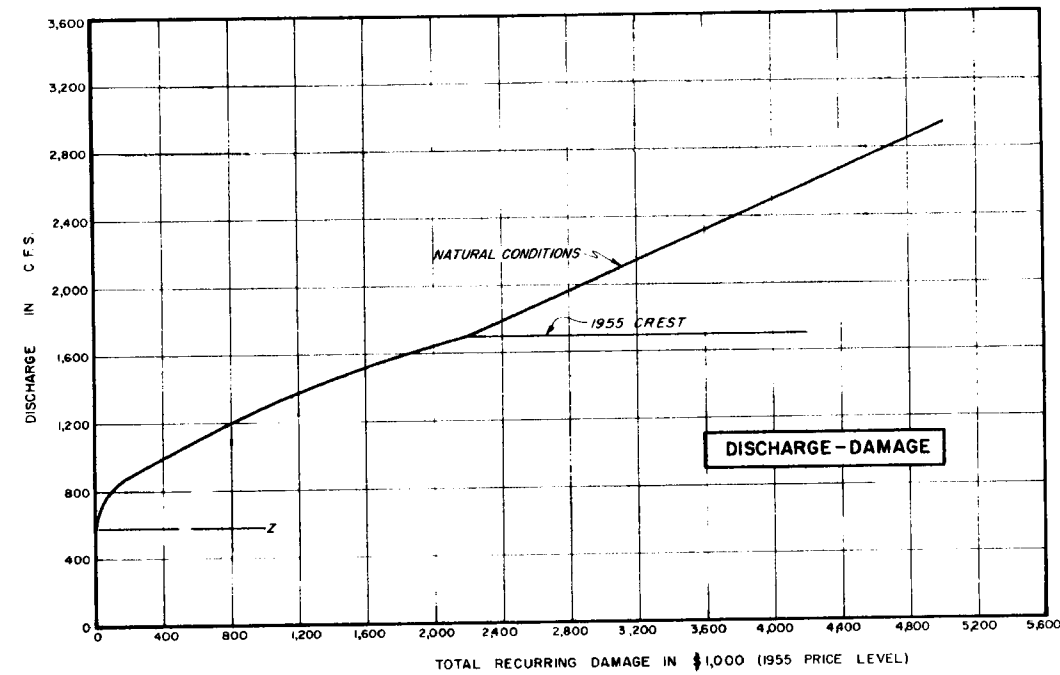


CORPS OF ENGINEERS U S ARMY OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION WILTHAM, MASS	
NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS	
LOCAL PROTECTION GENERAL PLANS	
DRY TR BY CBY SJC SJC MRH PROJECT ENGINEER APPROVED DATE	EAST BRANCH NEPONSET RIVER MASS DATE MARCH 1959 SCALE AS SHOWN DRAWING NUMBER SHEET





REVISION		DATE	DESCRIPTION	BY
CORPS OF ENGINEERS U. S. ARMY OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION WALTHAM, MASS.				
DR BY	TR BY	CR BY	NEPONSET RIVER FLOOD CONTROL CANTON, MASSACHUSETTS	
MARK	A.J.H.	M.R.H.	LOCAL PROTECTION DIVERSION CHANNEL PLAN	
PROJECT ENGINEER			EAST BRANCH NEPONSET RIVER, MASS.	
APPROVED			DATE	MARCH 1959
CHIEF ENGINEER DIV. 2			COL. C.E. ARIST. DIVISION CHIEF	
SCALE AS SHOWN				
DRAWING NUMBER				
SHEET 1 OF 1				



NEPONSET RIVER BASIN
DAMAGE — FREQUENCY
LOCAL PROTECTION AREA
CANTON, MASS.

APPENDIX A

APPENDIX A - STRUCTURAL COMPUTATIONS

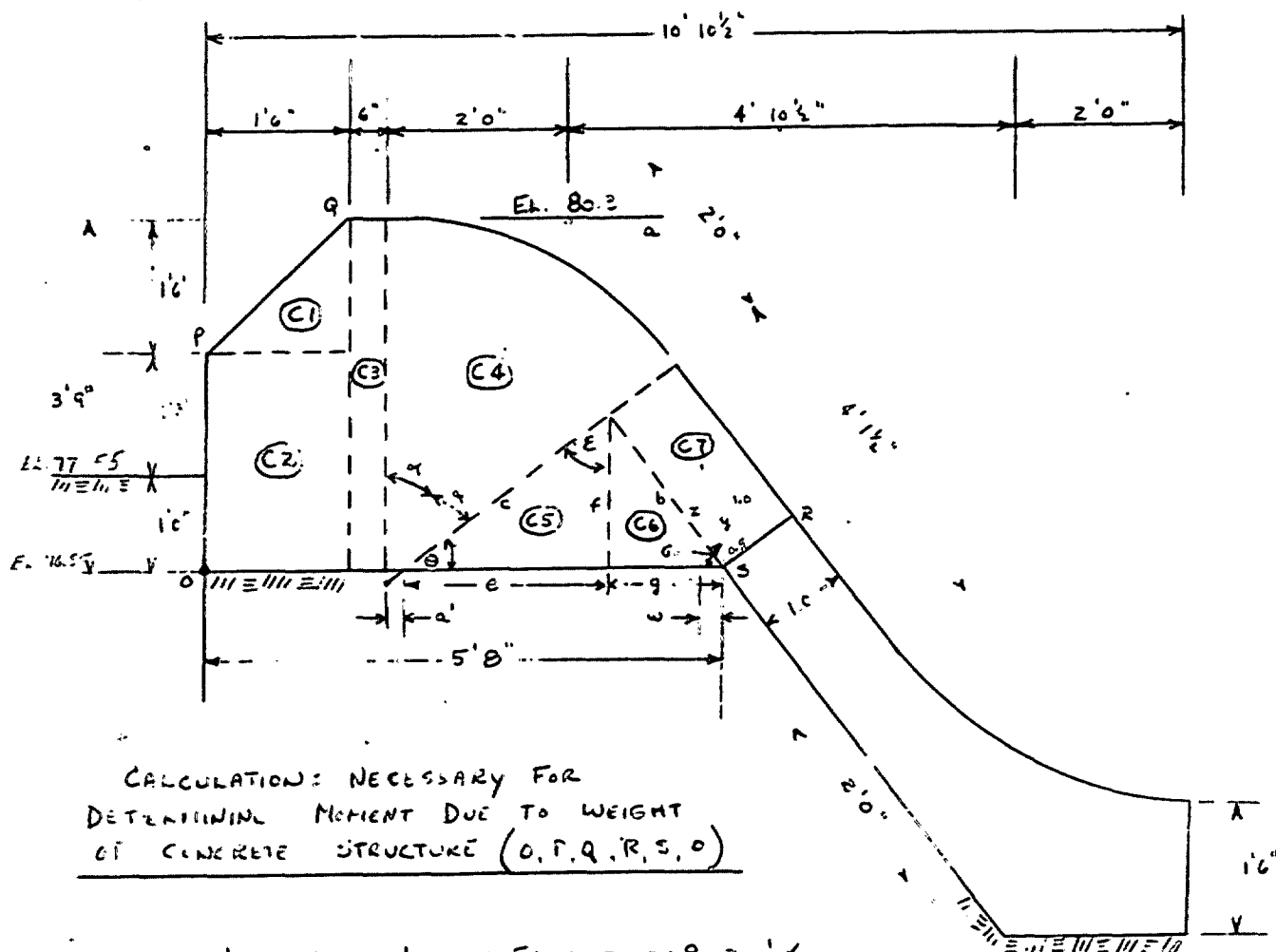
INDEX TO SHEETS

<u>TITLE</u>	<u>PAGE NO.</u>
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Construction Calculations	1 & 2
Moment Arm Calculations	3
Loading Condition No. I	4 & 5
Loading Condition No. II	6
Loading Condition No. IV	7 & 8
<u>WALL AT INTAKE STRUCTURE</u>	9 & 10
<u>GATE STRUCTURE STABILITY</u>	
Section 1 - 1	11
Forces	12, 13 & 14
Loading Computations	15 & 16
<u>STEEL REINFORCEMENT FOR SLAB</u>	17, 18 & 19

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PAGE 1

SUBJECT Final Report - NEPILSET RIVERCOMPUTATION WEIR STABILITY CONSTRUCTION CALCULATIONSCOMPUTED BY LCN CHECKED BY LCN DATE 1/27/59

$$\alpha = \tan^{-1} \frac{2}{4} = \tan^{-1} 0.5000 = 26^{\circ} 32'$$

$$2\alpha = 53^{\circ} 04'$$

$$u = 4 \tan 2\alpha = 4 \tan 53^{\circ} 04' = 4 (1.3303) = 5.321$$

$$a' = \frac{5.321 (4.0 - 3.75)}{4.0} = 0.333 \checkmark$$

$$\theta = 90^{\circ} - 2\alpha = 90^{\circ} - 53^{\circ} 04' = 36^{\circ} 56'$$

$$\text{AREA } (C4) = \frac{\pi (4)^2 (53.667)}{360} - \frac{(4.0 - 3.75)(0.333)}{2}$$

$$A = 7.43 - 0.04 = 7.39$$

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PAGE 2SUBJECT EAST BRANCH - NEPONSET RIVERCOMPUTATION WEIR STABILITY - CONSTRUCTION CALCULATIONS (CONT)COMPUTED BY RTB CHECKED BY JCW DATE 1/27/59

$$\begin{aligned} e + g &= 5.667 - (1.5 + 0.5 + 0.33) \\ &= 5.667 - 2.33 = \underline{3.337'} \end{aligned}$$

$$\begin{aligned} b &= 3.334 \sin \theta = 3.334 \sin 36^\circ 56' \\ &= 3.334 (.600) = \underline{2.00} \end{aligned}$$

$$\begin{aligned} c^2 &= (3.334)^2 - b^2 = 11.1 - 4.0 \\ c^2 &= 7.1 \\ c &= \underline{2.66} \end{aligned}$$

$$\underline{E} = 90^\circ - 36^\circ 56' = \underline{53^\circ 04'}$$

$$\begin{aligned} e &= c \sin E = 2.66 \sin 53^\circ 04' \\ &= 2.66 (.799) \\ &= \underline{2.12} \end{aligned}$$

$$\begin{aligned} f &= c \sin \theta = 2.66 \sin 36^\circ 56' \\ &= 2.66 (.600) \\ &= \underline{1.60} \end{aligned}$$

$$\begin{aligned} g &= (e + f) - e = 3.334 - 2.12 \\ &= \underline{1.21} \end{aligned}$$

$$\begin{aligned} y^2 &= (1.0)^2 + (0.5)^2 = 1.0 + .25 \\ y^2 &= 1.25 \\ y &= \underline{1.117} \end{aligned}$$

$$\begin{aligned} G &= E + \tan^{-1} \frac{.5}{1.0} = 53^\circ 04' + 26^\circ 32' \\ G &= \underline{79^\circ 36'} \end{aligned}$$

$$\begin{aligned} z &= y \cos G = 1.117 \cos 79^\circ 36' \\ &= 1.117 (.184) \\ &= \underline{1.099} \end{aligned}$$

$$\begin{aligned} w &= y \sin G = 1.117 \sin 79^\circ 36' \\ &= 1.117 (.181) \\ &= \underline{.202} \end{aligned}$$

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PAGE 3SUBJECT EAST BRANCHNEPHEWSET RIVERCOMPUTATION WATER STABILITY - MOMENT FROM CALCULATIONSCOMPUTED BY RTG CHECKED BY JG:W DATE 1/27/59CALCULATIONS FOR MOMENT AXIS

$$C1 \quad x = \frac{2}{3}(1.5) = 1.0 \quad \checkmark$$

$$C2 \quad x = \frac{1}{2}(1.5) = 0.75 \quad \checkmark$$

$$C3 \quad x = 1.5 + \frac{1}{2}(1.5) = 1.5 + .25 = 1.75 \quad \checkmark$$

$$C4 \quad \bar{x} = \frac{\frac{2}{3} r \sin \alpha}{\alpha} = \frac{2(4.0) \sin 26^{\circ} 32'}{3(.464)}$$

$$\bar{x} = \frac{2(4.0)(.447)}{3(.464)} = 2.58 \quad \checkmark$$

$$\frac{90}{\pi/2} = \frac{26.534}{x}$$

$$x = .464 \quad \checkmark$$

$$\theta + \alpha = 36^{\circ} 56' + 26^{\circ} 32'$$

$$= 63^{\circ} 28' \quad \checkmark$$

$$x = \bar{x} \cos(\theta + \alpha) = 2.58 \cos 63^{\circ} 28'$$

$$= 2.58(.447)$$

$$= 1.153 \quad \checkmark$$

$$x = 1.5 + 0.5 + 1.15 = 3.15 \quad \checkmark$$

$$C5 \quad x = 1.5 + 0.5 + 0.33 + \frac{2}{3}(2.12) = 1.5 + 0.5 + 0.33 + 1.41$$

$$x = 3.74 \quad \checkmark$$

$$C6 \quad x = 1.5 + 0.5 + 0.33 + 2.12 + \frac{1}{3}(1.21) = 1.5 + 0.5 + 0.33 + 2.12 + .40$$

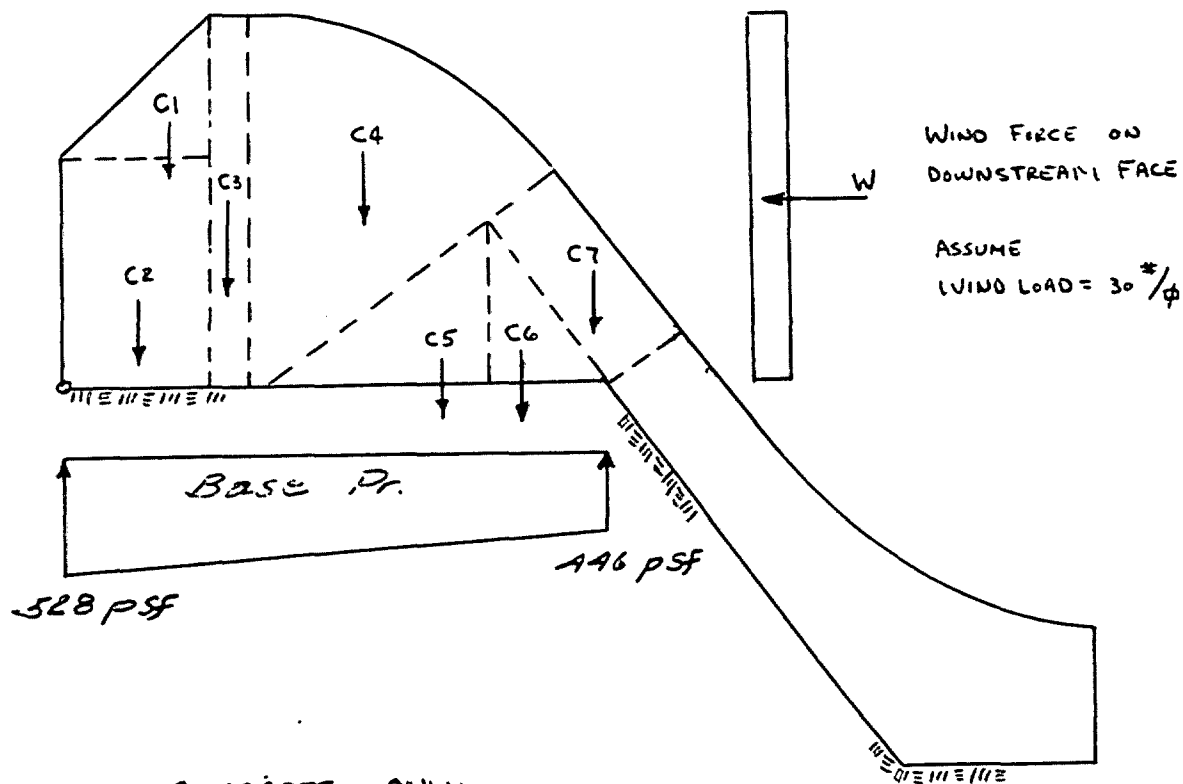
$$x = 4.85 \quad \checkmark$$

$$C7 \quad x = 1.5 + 0.5 + .33 + 2.12 + 1.21 - .20$$

$$x = 5.47 \quad \checkmark$$

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PAGE 4SUBJECT EAST BRANCH - NEPONSET RIVERCOMPUTATION WEIR STABILITY - LOADING CONDITION No. ICOMPUTED BY RTB CHECKED BY JEN DATE 1/27/59LOADING CONDITION No. I - CONSTRUCTION CONDITION

FORCE	FACTOR	V #	H	ARM	M 1#
C1	150 x 1.5 x 1.5 x 1/2	+ 169	-	1.00	+ 169.00
C2	150 x 1.5 x 2.25	+ 507	-	0.75	+ 380.00
C3	150 x 0.5 x 3.75	+ 281	-	1.75	+ 492.00
C4	150 x 7.39	+ 1110	-	3.15	+ 3500.00
C5	150 x 2.12 x 1.60 x 1/2	+ 254	-	3.74	+ 950.00
C6	150 x 1.21 x 1.60 x 1/2	+ 145	-	4.85	+ 703.00
C7	150 x 2.00 x 1.00	+ 300	-	5.47	+ 1640.00
		$\Sigma V = 2766.00$			$\Sigma M = 7834.00$

WITH WIND LOAD

CONCRETE	-	2766	-		+ 7834.00
WIND	30 x 3.75 x 1		- 113	1.88	- 212.00
		$\Sigma V = 2766.00$	$\Sigma H = 113$		$\Sigma M = 7622.00$

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PAGE 5SUBJECT EAST BRANCHNEPONSET RIVERCOMPUTATION WEIR STABILITYLOADING CONDITION No. I (CONT)COMPUTED BY RJBCHECKED BY JCADATE 1/27/59LOADING CONDITION No. I (CONT)OVERTURNING

$$5.67/3 = 1.89$$

WITHOUT WIND LOAD

$$\frac{\Sigma M}{\Sigma V} = \frac{7834}{2766} = 2.83 \quad \text{OK} \quad 1.89 < 2.83 < 3.78$$

$$e = 2.83 - 2.83 = 0$$

RESULTANT IN MIDDLE THIRD

WITH WIND LOAD

$$\frac{\Sigma M}{\Sigma V} = \frac{7622}{2766} = 2.75 \quad \text{OK} \quad 1.89 < 2.75 < 3.78$$

$$e = 2.83 - 2.75 = 0.08$$

RESULTANT IN MIDDLE THIRD

SLIDINGNONE $\Sigma H = 0$

$$\text{With wind Load - Base Pr.} = \frac{2766}{5.67} \left(1 \pm \frac{6 \times 0.08}{5.67} \right) = 488 (1 \pm .0846)$$

Pr. Upstream = 528 psf

Pr. Downstream = 446 psf

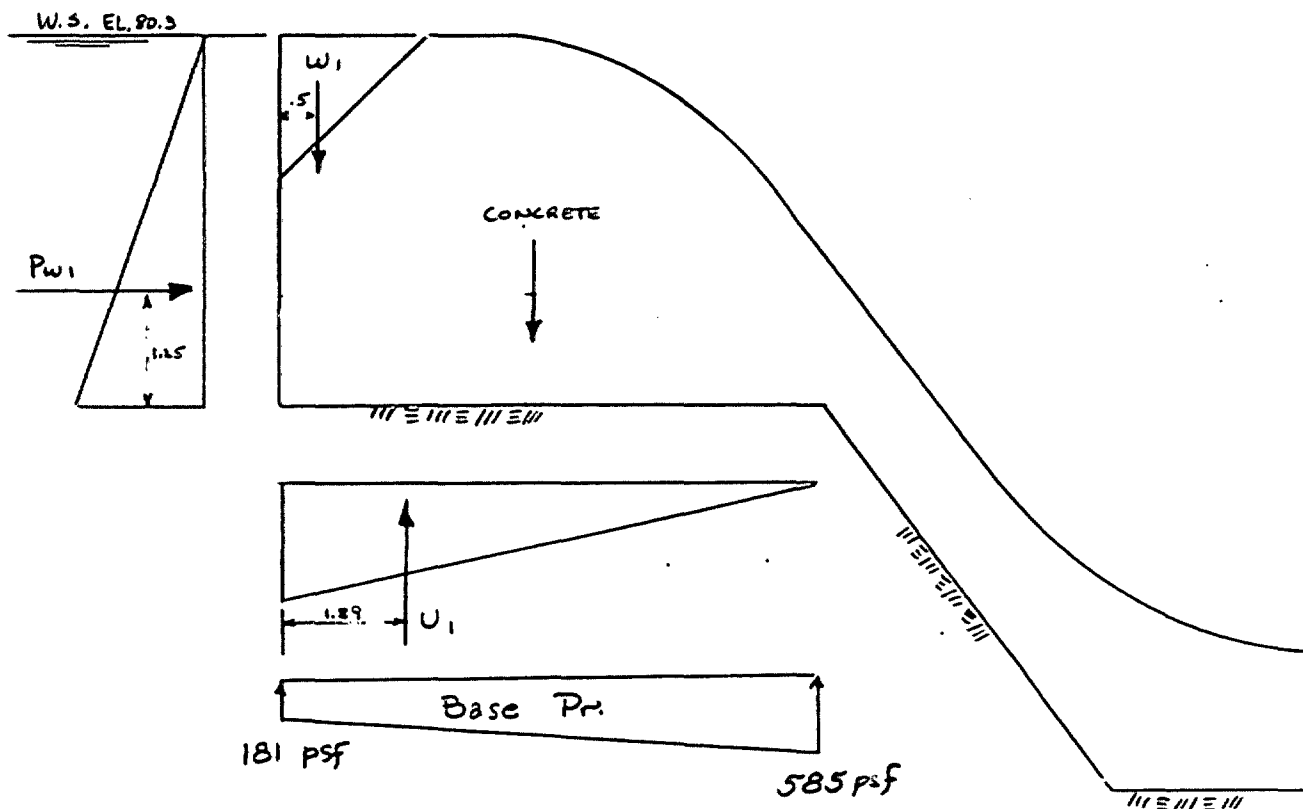
27 Sept 49

SUBJECT EAST BRANCH - NEPONSET RIVER

COMPUTATION WEIR STABILITY - LOADING CONDITION No. II

COMPUTED BY RTB CHECKED BY JCW DATE 1/27/59

LOADING CONDITION No II - NORMAL OPERATING CONDITION.



FORCE	FACTOR	V ^x	H	ARM	M ^{ft}
CONCRETE	-	+2766	-	-	+7834.0
P_{w1}	$62.5 \times (3.75)^2 \times \frac{1}{2}$	-	+438	1.25	+548.0
W_1	$62.5 \times 1.5 \times 1.5 \times \frac{1}{2}$	+70	-	0.50	+35.0
U_1	$62.5 \times 3.75 \times 5.67 \times \frac{1}{2}$	-665	-	1.89	-1255.0
		$\Sigma V = 2171$	$\Sigma H = 438$	$\Sigma M = 7162.0$	

OVERTURNING $\frac{\Sigma M}{\Sigma V} = \frac{7162}{2171} = 3.30$ OK $1.89 < 3.30 < 3.78$

$e = 2.83 - 3.30 = -0.50$ within mid $\frac{1}{3}$ OK

Base Pr. = $\frac{2171}{5.67} (1 \pm 6 \times 0.50 / 5.67) = 383 (1 \pm 0.529)$ Pr. Upstream = 181 psf Pr. Downstream = 585 psf

SLIDING $\frac{\Sigma H}{\Sigma V} = \frac{438}{2171} = .202$ OK $.202 < .65$

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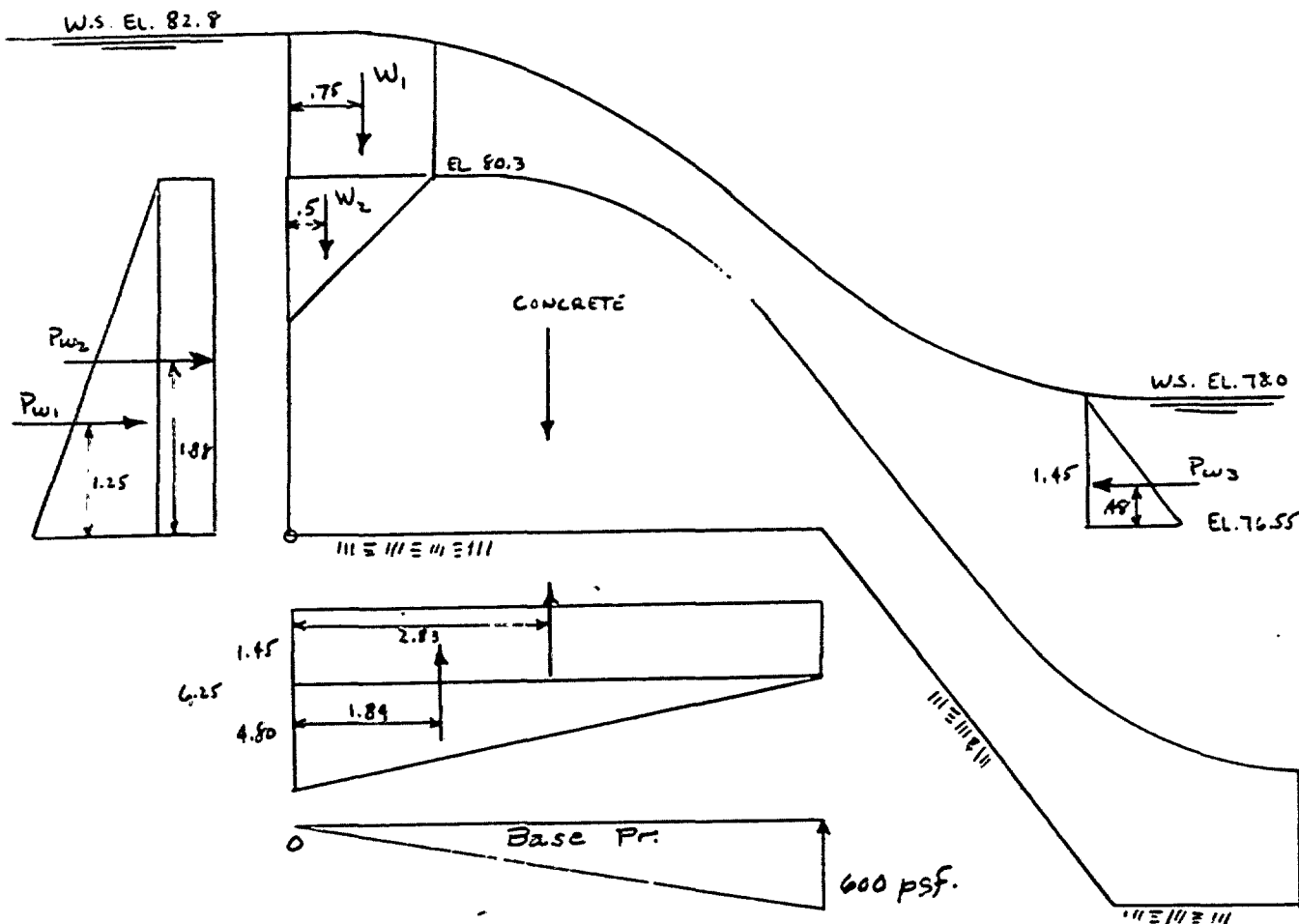
PAGE 7

SUBJECT EAST BRANCH - NEPONSET RIVER

COMPUTATION WEIR STABILITY - LOADING CONDITION No. IV

COMPUTED BY RTB CHECKED BY JEN DATE 1/27/59

LOADING CONDITION No. IV - FLOOD DISCHARGE CONDITION



FORCE	FACTOR	V #	H	ARM	M ¹⁴
CONCRETE	-	+ 2766	-	-	+ 7834.0
Pw1	$62.5 \times (3.75)^2 \times \frac{1}{2}$	-	+ 438	1.25	+ 548.0
Pw2	$62.5 \times 2.5 \times 3.75$	-	+ 586	1.88	+ 1100.0
Pw3	$62.5 \times (1.45)^2 \times \frac{1}{2}$	-	- 66	0.48	- 32.0
W1	$62.5 \times 2.5 \times 1.5$	+ 234	-	0.75	+ 176.0
W2	$62.5 \times 1.5 \times 1.5 \times \frac{1}{2}$	+ 70	-	0.50	+ 35.0
U1	$62.5 \times 1.45 \times 5.67$	- 515	-	2.83	- 1455.0
U2	$62.5 \times 4.80 \times 5.67 \times \frac{1}{2}$	- 851	-	1.89	- 1610.0

$\Sigma V = 1704$ $\Sigma H = 958$

$\Sigma M = 6596$

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PAGE 8SUBJECT EAST BRANCH - NEPONSET RIVERCOMPUTATION WEIR STABILITY - LOADING CONDITION No. IV (CONT)COMPUTED BY RTB CHECKED BY _____ DATE 1/27/59LOADING CONDITION No. IV (CONT)

$$\text{SLIDING} \quad \frac{\sum H}{\sum V} = \frac{958}{1704} = .56 \quad \text{OK} \quad .56 < .65$$

OVERTURNING

$$\frac{\sum M}{\sum V} = \frac{6596}{1704} = 3.87 \quad \text{OK} \quad 1.89 < 3.57 < 3.78$$

$$e = 2.83 - 3.87 = 1.04$$

$$3 + \frac{1}{3} \text{ point}$$

$$\text{Bas. Pr.} = \frac{1704 \times 2}{5.67} = 600 \text{ psf @ Toe}$$

$$= 0 \text{ @ Heel}$$

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PAGE 9SUBJECT East Branch - Neponset RiverCOMPUTATION Wall at Intake StructureCOMPUTED BY GFH CHECKED BY CntDATE 19 Feb. 59

El. 86.3

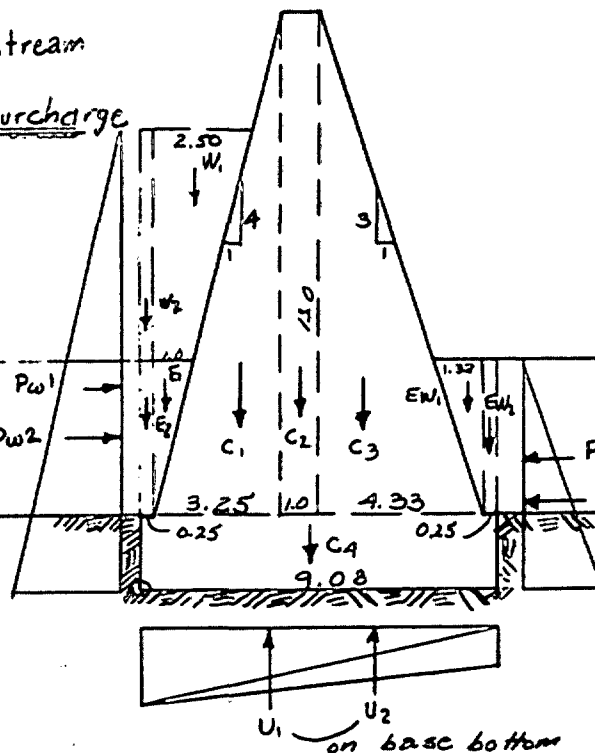
Upstream

El. 83.0 Surcharge

El. 77.0

El. 73.0

El. 71.0



Soil Assumptions

	Wt.	EFP
Dry	120	40
Moist	125	42
Sat.	135	45
Subm.	73	24

Existing Channel Bottom

Assumed Rock Surface

U₁ U₂
on base bottom

Case I: Maximum - water @ surcharge elev; lateral soil pressures balance.

Section @ el. 71.0

Unit	Factors	Force - KIPS				Arm Ft	Moment	
		↓	↑	→	←		↷	↶
C1	.15 X 3.25 X 6.5	3.170				2.42	7.68	
C2	.15 X 1.0 X 13.0	1.950				4.00	7.80	
C3	.15 X 4.33 X 6.5	4.220				5.94	25.10	
C4	.15 X 2.0 X 9.08	2.724				4.54	12.36	
E1	.073 X 1.0 X 2.0	.146				0.58	.08	
E2	.073 X 0.25 X 4.0	.073				0.125	.01	
W1	.0625 X 2.5 X 5.0	.781				1.08	.84	
W2	.0625 X 0.25 X 10.0	.156				0.125	.02	
EW1	0.135 X 1.33 X 2.0	.360				8.39	3.02	
EW2	0.135 X 4.0 X 0.25	.135				8.955	1.21	
U1	0.0625 X 6.0 X 9.08		3.405			3.03		10.31
U2	0.0625 X 3.0 X 9.08		1.702			6.06		10.31
Pw2	.0625 X 6.0 X 12.0			4.50		9.0	18.00	
Pw4	.0625 X 3.0 X 6.0				1.12	2.0		2.24
		13.715	5.107	4.50	1.12		76.12	22.86
		5.107		1.12			22.86	

 $\Sigma V = 8.608$ $\Sigma H = 3.38$ $\Sigma M = 53.26$

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CORPS OF ENGINEERS, U. S. ARMY

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SUBJECT East Branch - Neponset RiverCOMPUTATION Wall @ Intake StructureCOMPUTED BY GFH CHECKED BY Cmt DATE 19 Feb. 59

$$\Sigma M \div \Sigma V = 53.26 \div 8.608 = 6.18 \quad e = 4.54 - 6.18 = -1.64$$

$\approx 6.06 \text{ oh} \quad @ \text{ mid } 1/3$

$$\text{Base Pr.} = \frac{8.608}{9.08} \times 2 = 1.896$$

$$\text{Pr. @ heel} = 0 \quad \text{KSF} \quad \text{Pr. @ Toe} = 1.896 \text{ KSF} \quad h$$

$$\Sigma H / \Sigma V = 3.38 / 8.61 = .39 < .65 \text{ oh}$$

Section @ el. 73.0

Unit	Factors	Force - Kips				Arm Ft	Moment	
		↓	↑	→	←		↷	↶
C1		3.170				2.17	6.88	
C2		1.950				3.75	7.31	
C3		4.220				5.69	24.00	
E1		.146				.333	.05	
W1		.781				.833	.65	
EW1		.360				8.14	2.93	
U1	.5X.0625X5X8.58		1.340			2.86		3.83
U2	.5X.0625X2.0X8.58		.536			5.72		3.07
PW1	.0625X5X10			3.125		3.33	10.42	
PW3	.0625X2X4				.500	1.33		0.67
		10.627	1.876	3.125	.500		52.24	7.57
		1.876		.500			7.57	

$$\Sigma V = 8.751 \quad \Sigma H = 2.625$$

$$\Sigma M = 44.67$$

$$\Sigma M \div \Sigma V = 44.67 \div 8.751 = 5.11$$

$$2.5 < 5.11 < 5.72$$

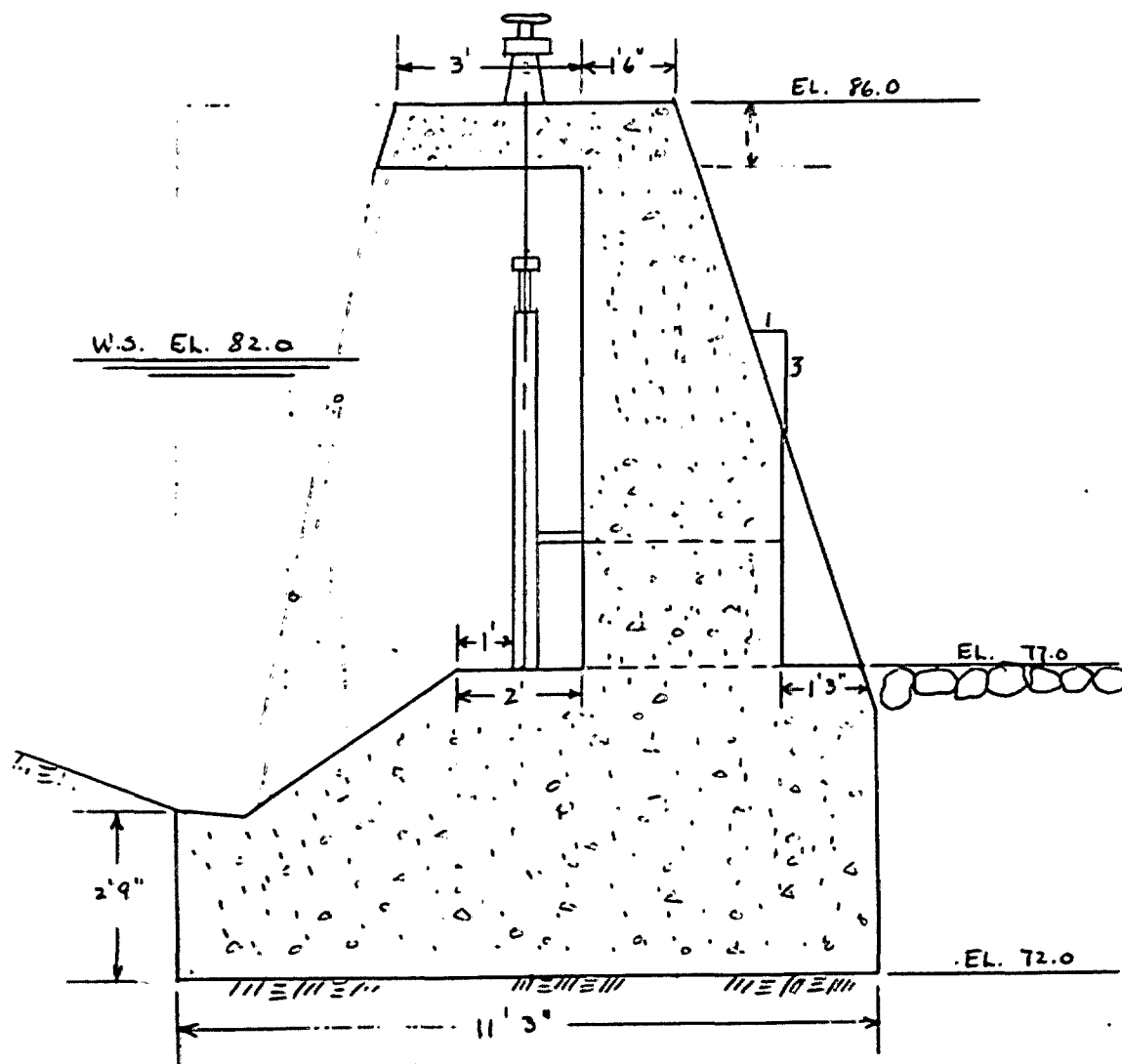
No tension OK

27 Sept 49

CORPS OF ENGINEERS, U.S. ARMY

PAGE

11

SUBJECT EAST BRANCH - NEPONSET RIVER - GATE STRUCTURECOMPUTATION GATE STRUCTURE STABILITY SECTION 1-1COMPUTED BY RJR CHECKED BY JLW DATE 1/29/59SECTION 1-1
SCALE 1" = 3'

27 Sept 49

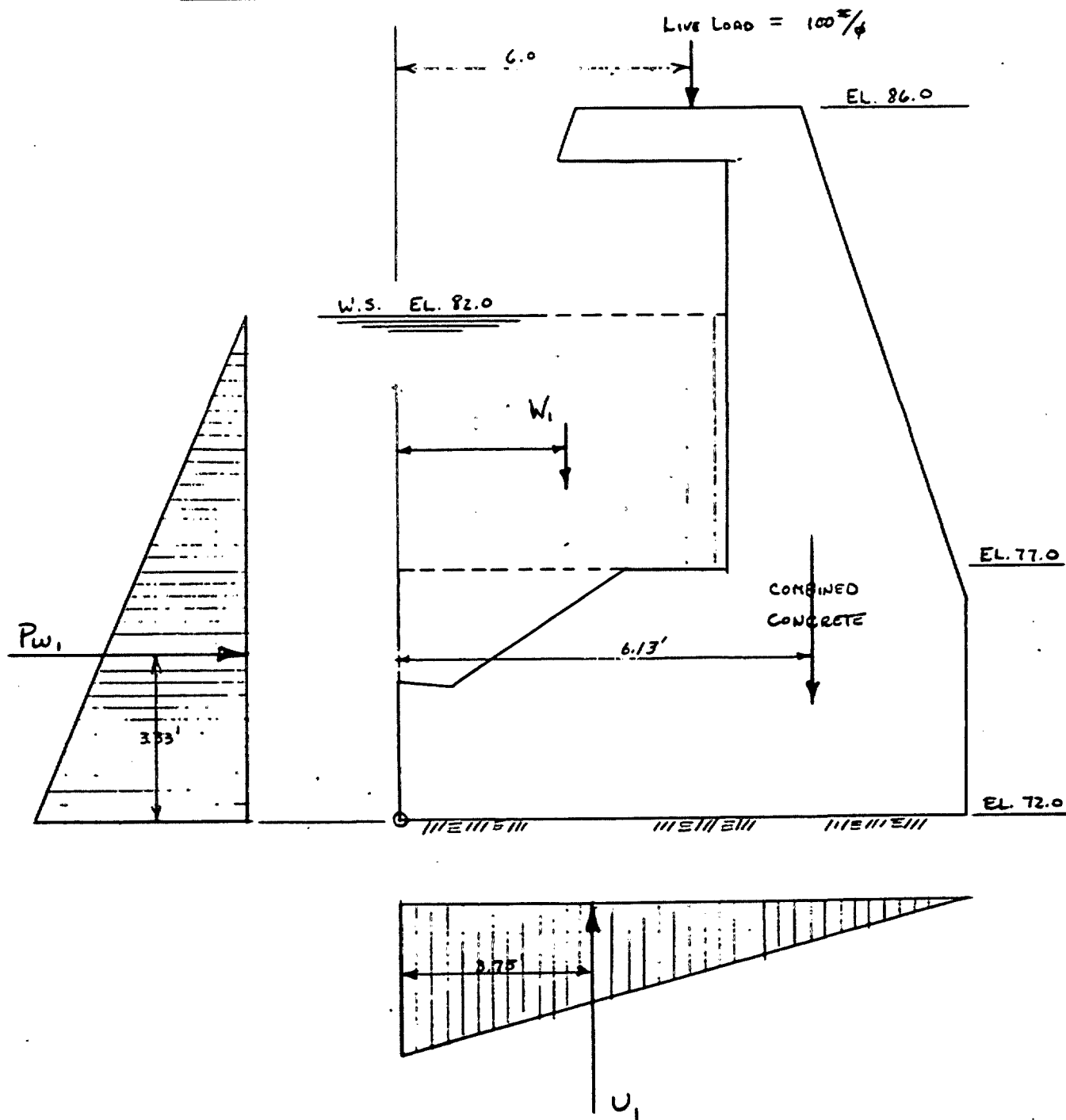
CORPS OF ENGINEERS, U.S. ARMY

SUBJECT EAST BRANCH - NEPONSET RIVER -

COMPUTATION GATE STRUCTURE STABILITY - FORCES

COMPUTED BY RJB CHECKED BY JCV DATE 1/29/59

FORCES ACTING ON STRUCTURE



27 Sept 49

SUBJECT EAST BRANCH

NEPONSET RIVER

COMPUTATION GATE STRUCTURE STABILITY - CONCRETE FORCES

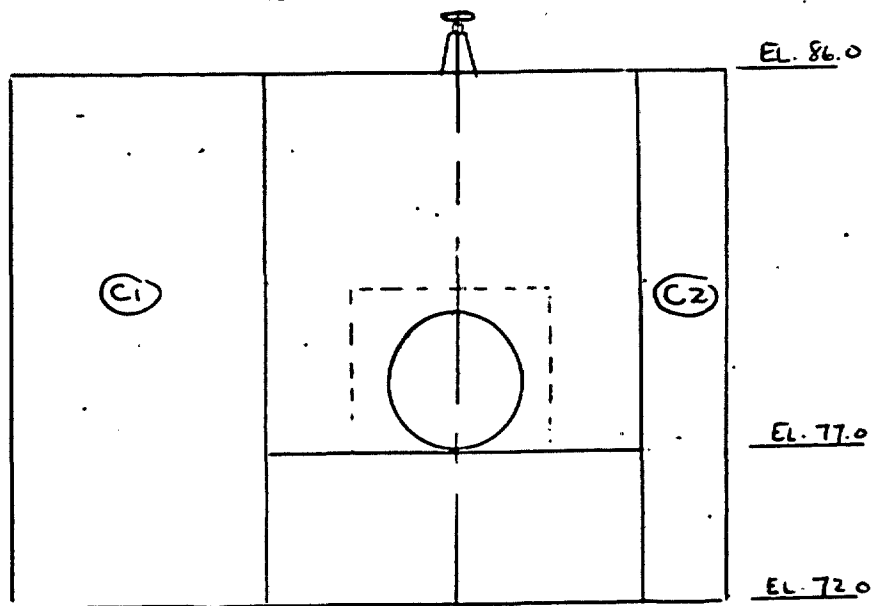
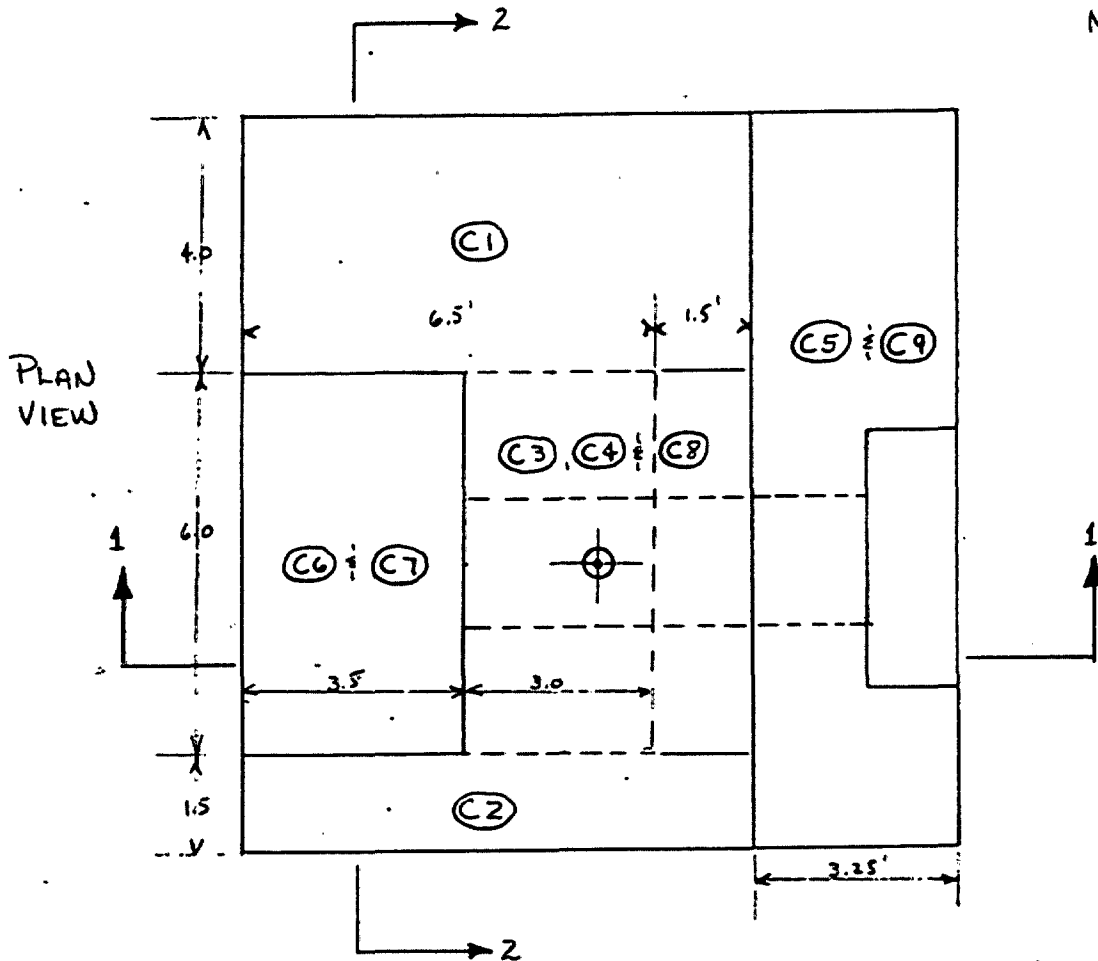
COMPUTED BY RJB

CHECKED BY JCN

DATE 1/29/59

CONCRETE FORCES

NOTE:
NOT TO SCALE



SECTION 2-2

27 Sept 49

CORPS OF ENGINEERS, U.S. ARMY

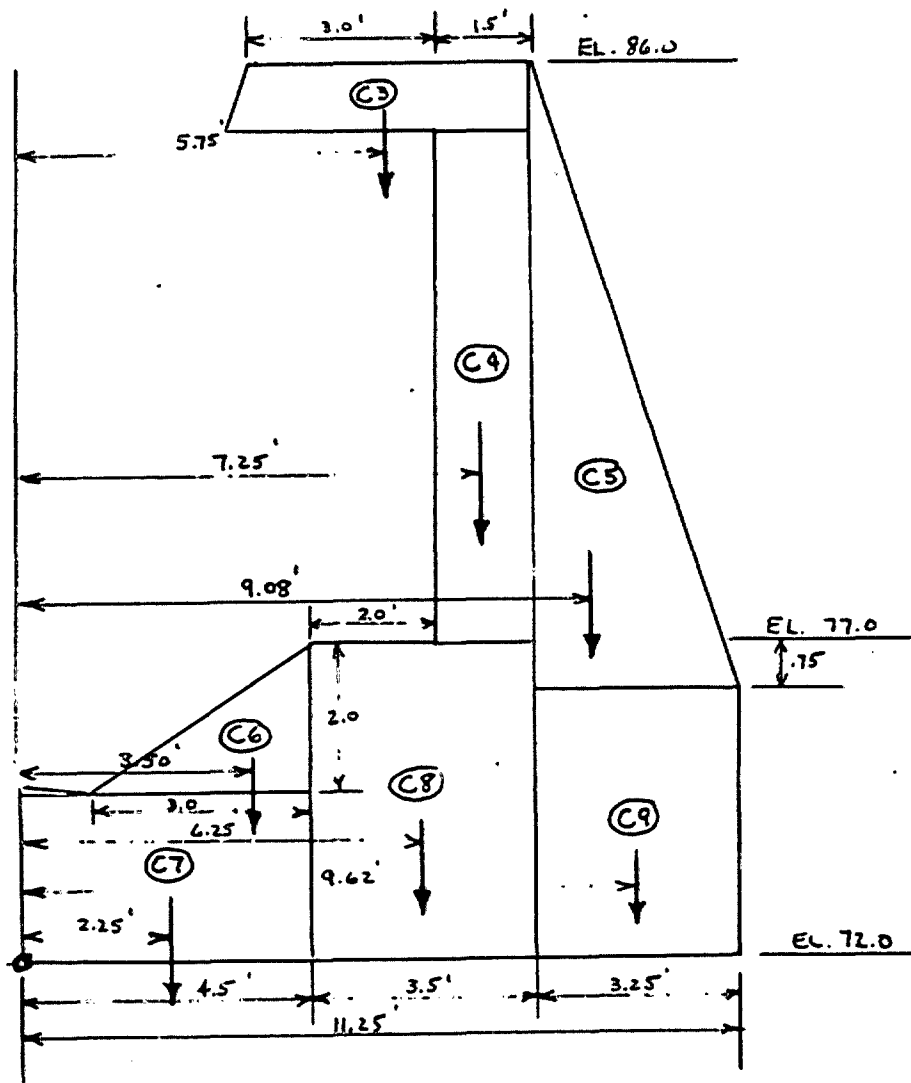
PAGE 14

SUBJECT EAST BRANCH - NEPONSET RIVER

COMPUTATION GATE STRUCTURE STABILITY - CONCRETE FORCES

COMPUTED BY RJB CHECKED BY JCK DATE 1/29/59

CONCRETE FORCES



SECTION 1-1

27 Sept 49

SUBJECT EAST BRANCH - NEWBURY RIVER

COMPUTATION GATE STRUCTURE STABILITY - LOADING COMPUTATIONS

COMPUTED BY RJE CHECKED BY ICW DATE 1/29/59

CONCRETE ONLY, FOR ENTIRE BLOCK

FORCE	COMPUTATIONS	V	H	ARM	M
C1	150 x 8 x 4 x 14	67,200		4.0	268,800
C2	150 x 8 x 1.5 x 14	25,200		4.0	100,800
C3	150 x 4.5 x 6 x 1	4,050		5.75	23,300
C4	150 x 1.5 x 6 x 8	10,800		7.25	78,400
C5	150 x 3.25 x 9.75 x 11.5 x 1/2	27,350		9.08	248,000
C6	150 x 2.0 x 3.0 x 6.0 x 1/2	2,700		3.50	9,450
C7	150 x 2.75 x 4.5 x 6	11,150		2.25	25,100
C8	150 x 5 x 3.5 x 6	15,750		6.25	98,400
C9	150 x 4.25 x 3.25 x 11.5	23,800		4.62	229,000
		$\Sigma V = 188,000$			$\Sigma M = 1,081,250$

LOADING CONDITIONS - WATER LEVEL @ EL. 82.0, GATE CLOSED.
NO TAILWATER. ASSUME LIVE LOAD = 100 #/sq

FORCE	COMPUTATIONS	V	H	ARM	M
CONCRETE	-	+ 188,000	-	-	+ 1,081,250
LIVE LOAD	100 x 4.5 x 6.0	+ 2,700	-	6.00	+ 16,200
Pw	62.5 x (10) ² x 1/2 x 11.5	-	+ 3590	3.33	+ 11,950
W ₁	62.5 x 5 x 6 x 6.50	+ 12,200	-	3.25	+ 39,700
U ₁	62.5 x 10 x 11.25 x 1/2 x 11.5	- 40,500	-	3.75	- 152,000
		$\Sigma V = 162,400$	$\Sigma H = 3590$		$\Sigma M_I = 997,100$

(WITHOUT LIVE LOAD) $\Sigma V = 159,700$

$\Sigma M_I = 980,900$

SLIDING $\frac{\Sigma H}{\Sigma V} = \frac{3590}{162,400} = .022$ OK $.022 < .65$

OVERTURNING $\frac{\Sigma M_I}{\Sigma V} = \frac{997,100}{162,400} = 6.13$ OK

(WITH LIVE LOAD)

RESULTANT IN MIDDLE THIRD OF BASE

$$11.25 \div 3 = 3.75'$$

$$3.75' < 6.13' < 7.50'$$

27 Sept 49

CORPS OF ENGINEERS, U.S. ARMY

PAGE 16SUBJECT EAST BRANCH - NEPONSET RIVERCOMPUTATION GATE STRUCTURE STABILITY - LOADING COMPUTATIONSCOMPUTED BY RJB CHECKED BY JCW DATE 1/25/59OVERTURNING

(WITHOUT LIVE LOAD)

$$\frac{\sum M_I}{\sum V} = \frac{980,200}{159,700} = 6.15 \quad \text{OK}$$

RESULTANT IN MIDDLE THIRD OF
BASE

$$\frac{11.25}{3} = 3.75$$

$$3.75' < 6.15' < 7.50'$$

27 Sept 49

CORPS OF ENGINEERS, U. S. ARMY

PAGE 17

SUBJECT EAST BRANCH - NEPONSET RIVER - GATE STRUCTURECOMPUTATION STEEL REINFORCEMENT FOR SLABCOMPUTED BY RJB CHECKED BY SL DATE 1/30/59CONCRETE DATA

$$\begin{aligned}
 f'_c &= 3000 \text{ psi} \\
 f_s &= 20,000 \text{ psi} \\
 f_c &= 1050 \text{ psi} \\
 k &= 160 \\
 j &= .885
 \end{aligned}$$

$$\begin{aligned}
 \text{LIVE LOAD} &= 100 \text{ psf} \\
 \text{DEAD LOAD} &= 150 \text{ psf} \\
 \text{CONCENTRATED LOAD} &= 1500 \#
 \end{aligned}$$

SLAB 3'6" x 7'0"

ASSUME DEPTH = 8"MOMENT

$$M = \frac{1}{8} w l^2$$

$$M = \frac{1}{8} \times 200 \times (7)^2 \times 12$$

$$M = 14,700 \text{ in-lb}$$

$$M = \frac{Pl}{4}$$

$$M = \frac{1500 \times 7 \times 12}{4}$$

$$M = 31,500 \text{ in-lb}$$

$$\text{TOTAL } M = 14,700 + 31,500 = 46,200 \text{ in-lb.}$$

$$LL = 100$$

$$DL = \frac{8 \times 12}{144} \times 150 = 100$$

$$w = 100 + 100 = 200 \#/\text{LF}$$

$$M = Kbd^2$$

$$d^2 = \frac{M}{Kb} = \frac{46,200}{160 \times 12}$$

$$d = \sqrt{24.1} = 4.91" \checkmark \quad \text{ADD } 2" \text{ COVER}$$

$$d = 4.91" + 2" = 6.91"$$

8" DEPTH OK

27 Sept 49.

CORPS OF ENGINEERS, U. S. ARMY

PAGE 18SUBJECT EAST BRANCH - NEPONSET RIVER - GATE STRUCTURECOMPUTATION STEEL REINFORCEMENT FOR SLABCOMPUTED BY RTB CHECKED BY JCW DATE 1/30/59STEEL REQUIRED

$$A_s = \frac{M}{f_s j d} = \frac{46,200}{20,000 \times .885 \times 8}$$

$$A_s = .326 \text{ sq. in.}$$

$$A_s \text{ No. 6 BAR} = .44 \text{ sq. in.}$$

$$\frac{.326}{.44} = .74 \text{ BARS/FOOT OF WIDTH}$$

$$\text{WIDTH} = 3'6" \therefore \underline{\text{USE 3 - No. 6 BARS}}$$

SHRINKAGE & TEMPERATURE STEEL

$$A_s = .0025 \times 8 \times 12$$

$$A_s \text{ No. 4 BAR} = .20 \text{ sq. in.}$$

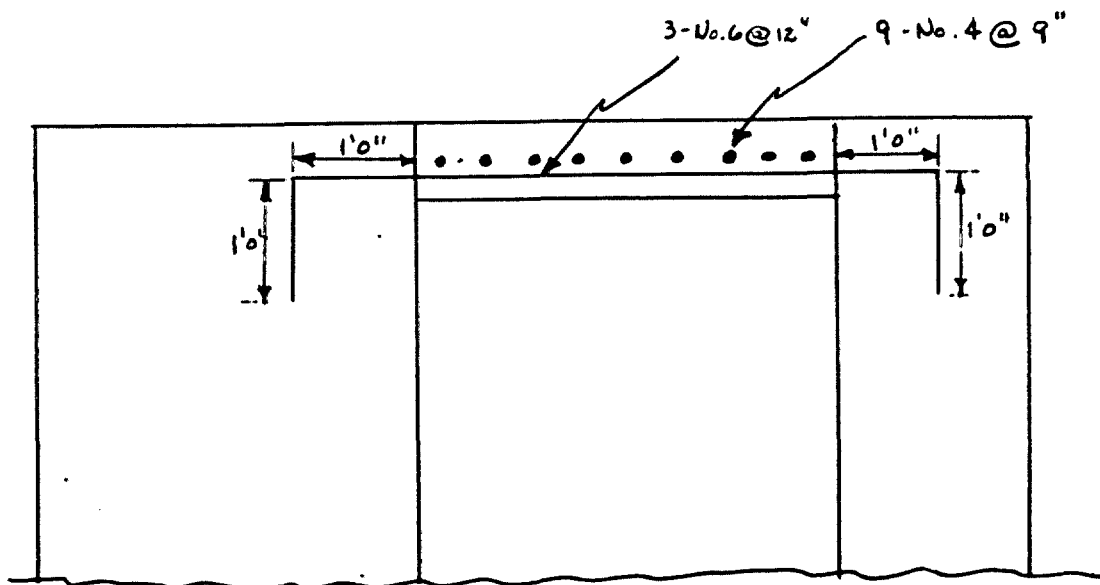
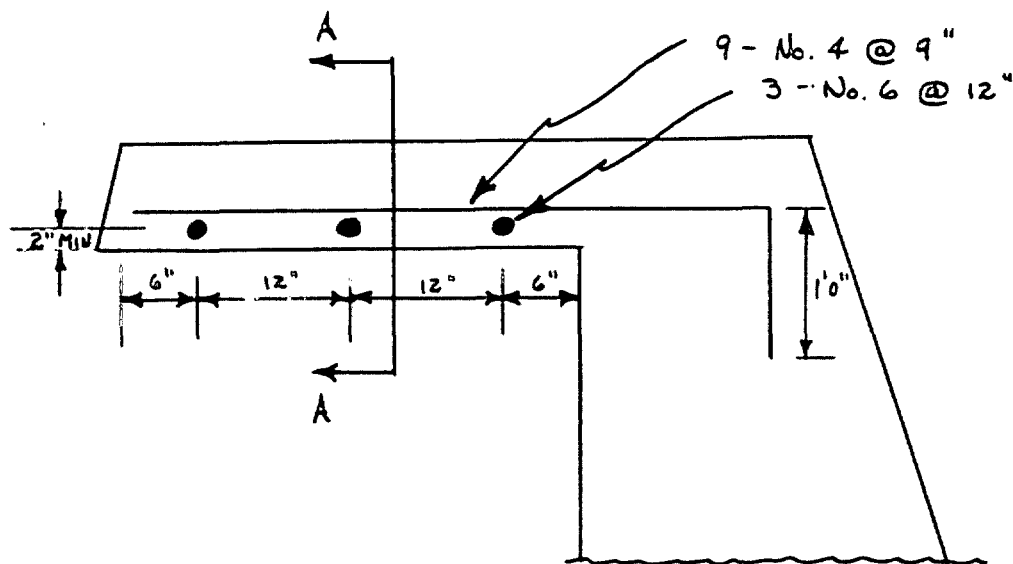
$$A_s = .24 \text{ sq. in.}$$

$$\frac{.24}{.20} = 1.2 \text{ BARS/FOOT OF SLAB}$$

$$\text{SLAB LENGTH} = 7'0" \therefore \underline{\text{USE 9 - No. 4 BARS}}$$

27 Sept 49

CORPS OF ENGINEERS, U. S. ARMY

PAGE 19SUBJECT EAST BRANCH - NEPONSET RIVER - GATE STRUCTURECOMPUTATION STEEL REINFORCEMENT FOR SLABCOMPUTED BY ETC CHECKED BY _____ DATE 1/24/59REINFORCING STEEL

SECTION A-A

NOTE: NOT TO
SCALE

APPENDIX B

LETTERS OF COMMENT AND CONCURRENCE

<u>Exhibit No.</u>	<u>Agency</u>	<u>Letter Dated</u>
1	Town of Canton, Massachusetts	Dec 17, 1958
1-A	Plymouth Rubber Co., Inc.	Nov 28, 1958
1-B	New England Corps of Engineers	Nov 13, 1958
2	Town of Canton, Mass.	Oct 21, 1958
2-A	New England Corps of Engineers	Sep 19, 1958
3	Town of Canton, Mass.	Apr 16, 1958
4	Town of Canton, Mass.	Feb 20, 1959
4-A	Article 27 of the Warrant for Town of Canton	
5	Copy of Letter from Town of Canton to Metropolitan District Commission, Boston, Mass.	Dec 23, 1958
6	The Commonwealth of Massachusetts Department of Public Works	Dec 30, 1958
7	The Commonwealth of Massachusetts Metropolitan District Commission	Jan 19, 1959
8	U. S. Department of Agriculture Soil Conservation Service	May 26, 1958
9	U. S. Department of Commerce Bureau of Public Roads	Aug 18, 1958
10	U. S. Department of Health, Education and Welfare	Jul 18, 1958
11	U. S. Department of Fish and Wildlife Service	Sep 22, 1958
12	Town of Canton, Mass.	Mar 18, 1959
13	Plymouth Rubber Co., Inc.	Mar 6, 1959
13-A	Plymouth Rubber Co., Inc. (Certificate of Corporate Vote)	
13-B	Inclosure to Exhibit 13	



Town of Canton, Massachusetts

OFFICE OF THE SELECTMEN

MEMORIAL HALL

December 17, 1958

Division Engineer
U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Dear Sir:

Reference is made to letter from your office dated November 13, 1958 requesting additional data to be presented to the Chief of Engineers to show the importance of the proposed local flood protection project to the Town of Canton.

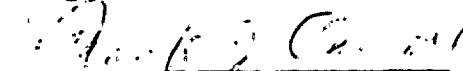
Enclosed herewith is a copy of a letter received from the Plymouth Rubber Company which supplies much of the information desired.

Further damage would have been caused to the center of Canton in the flood of August 1955 if it were not for the fact that Reservoir Pond easterly of Pleasant Street had been many feet below normal and did not overflow until 1800 hours on 19 August, 1955. This fact has been considered in the design of the proposed diversion.

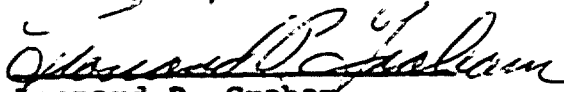
The diversion of the East Branch of the Neponset River around the Plymouth Rubber Company will reflect an immediate benefit to the village section of Canton surrounding Forge Pond, Massapoag Brook and Pequit Brook by allowing the complete opening of the Forge Pond Dam at Washington Street when necessary.

Attempts have been made and are continuing to be made to obtain a copy of the reports of the Federal Civil Defense Agency to amplify the damages caused by the 1955 floods. As soon as received, these reports will be forwarded to your office.

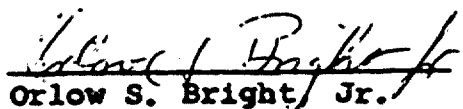
Very truly yours,



Frank J. Carroll



Leonard P. Graham



Orlow S. Bright Jr.

BOARD OF SELECTMEN

CGB:M

PLYMOUTH RUBBER COMPANY, INC.

THE LARGEST RUBBERIZERS OF CLOTH IN THE WORLD

RUBBERIZED FABRICS
QUARTERLININGS
HOSPITAL SHEETINGS
PLASTIC GARDEN HOSE
ELECTRICAL TAPES



HEELS - CREPE - SPORTSOLES
PLASTIC PRODUCTS
PLASTIC FILM AND SHEETING
SELF-ADHERING WALLPAPER
RUBBER BANDS

CANTON, MASS., U.S.A.

TELEPHONE CANTON 6-0220

November 28, 1958

Mr. J. Edward Bamber
Supt. of Public Works
Town of Canton
Canton, Massachusetts

Dear Mr. Bamber:

We are in receipt of your letter of November 21, enclosing a copy of letter received from the U. S. Army Engineer Corps to the Board of Selectman asking us to furnish certain data about our company to be considered in connection with the proposed flood control project.

Plymouth Rubber Company, Inc. employs about 825 people at an annual labor cost of over \$4,000,000. About 30% of our employees live in Canton. Our annual sales are approximately \$20,000,000. As the largest single employer in Canton, our firm is a major factor in the economy of the town through local purchase of materials and services by the company and by the consumption of consumer goods by our employees. Our out-of-town employees also make a substantial contribution to the economy of the town through the purchase of various items.

The proposed diversion of the East Branch of the Neponset River around our plant will definitely be beneficial to the town in various ways. It will definitely eliminate a repetition of what took place in 1955 where the center of the town was flooded due to the size of the culvert on our property being insufficient to take care of a large flow of water. With this proposed project, regardless of the amount of water that might come through from Massapoag or any of the outlying districts, the main gates on Washington Street can be controlled to take care of all of the water that is necessary; and this proposed diversion will definitely eliminate any flooding to townspeople, storekeepers, as well as the Plymouth Rubber Company, Inc., all of whom were badly damaged in the last flood.

We trust this is the information you desire, and if there is any further data necessary, please do not hesitate to contact us.

Very truly yours,

Frank Harris

Frank Harris
Vice President CHICAGO

EXHIBIT 1-A

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD

WALTHAM 54. MASS.

ADDRESS REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

13 November 1958

Francis J. Carroll, Chairman
Board of Selectmen
Town of Canton
Canton, Massachusetts

Dear Mr. Carroll:

Reference is made to letter from your Board of Selectmen dated October 21, 1958 stating that the Town of Canton, subject to the vote of the town meeting, will comply with the local cooperation required by law for the local protection project for the diversion of flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant.

The plan you prefer is one of three plans presented to you for consideration. The joint plan you favored, in letter to this office dated April 16, 1958, is a combination of the plan you now prefer and the diversion of the flood flows of Massapoag Brook across Washington Street through a canal which would also cross Neponset Street and join the canal for the East Branch Neponset River diversion. In the joint plan, the diversion dam and the canal for diverting the flood flows of the East Branch Neponset River would be smaller in size than for the selected plan. The selected plan is predicated on one project with no proposed future expansion for the diversion of the flood flows of Massapoag Brook. Furthermore, Public Law 685 provides "that the work shall be complete in itself and not commit the United States to any additional improvements to insure its successful operation, except as may result from preliminary examination and survey reports."

It is our understanding that, if the Chief of Engineers approves for construction the plan for diverting the flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant, no other local flood protection project can be constructed in Canton under the provisions of Public Law 685.

In letter from this office dated 4 March 1958 there was outlined the local cooperation required by law. Included in this letter was the statement that "If conditions warrant, the Chief of Engineers may require local cooperation which deviates from the usual local requirements. For example, if a project would be only for the betterment of one industry, a sizable local contribution to the cost of the project may be justified." In this connection, please furnish this office with data which may be

EXHIBIT 1-B

Francis J. Carroll

13 November 1958

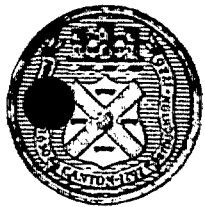
presented to the Chief of Engineers to show the importance of the proposed local protection project to the town of Canton. Such data should include information regarding the Plymouth Rubber Company as to the number of employees, amount of payroll, value of products, etc., and how flood damage to this company reflects on the economy of the town.

A conscientious effort will be made to obtain approval of the proposed project so that construction work may be initiated next spring.

Very truly yours,

RAYMOND A. SEIFERT
Lt. Colonel, Corps of Engineers
Executive Officer

cc: Mr. Edward J. Bamber
Superintendent of Public Works
Town of Canton



Town of Canton, Massachusetts

OFFICE OF THE SELECTMEN

MEMORIAL HALL

October 21, 1958

Colonel Stanley W. Dziuban
Corps. of Engineers
New England District
Waltham, Massachusetts.

Dear Sir:

In reply to your letter of 19 September 1958, the Board of Selectmen wish to state that plans to provide funds to cover the non-Federal project costs of joint plan (divert both the East Branch of the Neponset River and Massapoag Brook) have not been as yet successfully completed.

We are most desirous of having a protective flood control project proceed here in Canton. At this time, as a result of our meetings, discussions and studies, we request that the scope of the local protective project be limited to the diversion of the East Branch of the Neponset River in the vicinity of the Plymouth Rubber Company. The benefits of such a diversion alone will be reflected upstream to allow immediate discharge of flood flows from Forge Pond and thus prevent the backing up of Massapoag Brook in the vicinity of Bolivar, Mechanic, Rockland and Walnut Streets.

The Town of Canton, subject to a vote of the Town Meeting, will comply with the local cooperation required by law as outlined in paragraph three of your letter of 19 September, 1958.

As a result of this letter, it is hoped that your office will complete the plans for this local flood protective work in the near future and submit same to the Chief of Engineers for his considerations.



Town of Canton, Massachusetts

OFFICE OF THE SELECTMEN

MEMORIAL HALL

Colonel Stanley W. Dziuban

2

October 21, 1958

The co-operation of your office in the past has been most grateful and it is hoped that we may see this proposed project through to its successful completion.

Very truly yours,

Frank J. Cronin

William J. Cronin

William J. Cronin

BOARD OF SELECTMEN

CBG:P

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND

CORPS OF ENGINEERS

424 TRAPELO ROAD
WALTHAM 54, MASS.

URGENT REPLY TO:
DIVISION ENGINEER

REFER TO FILE NO.

NEDGW

19 September 1958

Francis J. Carroll, Chairman
Board of Selectmen
Town of Canton
Canton, Massachusetts

Dear Mr. Carroll:

In letter of 4 March 1958 from this office to you, there were outlined three feasible plans for possible flood protection works in the town of Canton, and the local cooperation required by law for the construction of a local flood control project. Your letter of 16 April 1958 requested that we complete the joint plan which would provide for the diversion of flood flows of the East Branch Neponset River around the Plymouth Rubber Company plant, and divert flood flows of Massapoag Brook across Washington Street through a canal which would also cross Neponset Street and end at Factory Pond. Your letter also stated that you would attempt to provide funds to cover the non-Federal project costs.

The Division Engineer would like to have completed, in the near future, plans for the Canton project and have them submitted to the Chief of Engineers for his consideration. Before he will recommend the project for construction, local interests must give him reasonable assurances that they will comply with the local cooperation required by law. Such assurances may state that they are subject to approval of a vote by the town. If local assurances are not forthcoming, the Division Engineer will submit a report to the Chief of Engineers recommending against construction of the proposed project, solely because local interests did not give assurances of cooperation.

If you still favor the proposed local protective project, I would appreciate a letter from you stating that, subject to a vote of the town in a meeting which has been or will be called for that purpose, the Town of Canton, Mass., will (a) furnish without cost to the United States all new bridges, relocations of buildings, roads, bridges, utilities, sewers, related and special facilities, local betterments required because of the work, lands, easements, and rights-of-way necessary for the construction of the project; (b) hold and save the United States free from damage due to the construction of the work; (c) maintain and operate all work after completion in accordance with regulations prescribed by the Secretary of the Army; and (d) agree to furnish all construction funds needed should the project cost exceed the Federal limitation of \$400,000. The results of the town vote regarding the proposed project should be furnished to the Division soon after they are known.

EXHIBIT 2-A

Francis J. Carroll, Chairman
Board of Selectmen, Town of Canton

19 September 1958

If the State of Massachusetts furnishes assurances for item (d) above, in lieu of the Town of Canton, that would be a satisfactory arrangement.

Sincerely yours,

STANLEY W. DZIUBAN
Colonel, Corps of Engineers
Acting Division Engineer

cc: Edward J. Bamber
Superintendent of Public Works
Town of Canton, Mass.



Town of Canton, Massachusetts

OFFICE OF THE SELECTMEN

MEMORIAL HALL

April 16, 1958

Corps of Engineers U. S. Army
Office of the Division Engineer
New England Division
150 Causeway Street
Boston 14, Massachusetts

Dear General Sibley:

LOCAL PROTECTIVE WORK- CANTON, MASS.

With reference to the above project for flood control along the East Branch of the Neponset River and Massapoag Brook, under authority of Public Law 685, it is requested that your office continue with the necessary steps to complete the joint plan.

We are deeply appreciative to your office of the work and preliminary plans, and in particular to Messrs. Wesley Restall, Alva J. Armstrong and Marshall R. Hopper, who attended an evening meeting here in Canton on March 25, 1958 and explained, in detail, the work and costs involved in the above project.

While your office is processing this project, the Town of Canton, will attempt to provide or secure the necessary funds to cover the Non-Federal costs.

It is intended to secure aid from the Commonwealth of Massachusetts through its various departments. Also we will keep our representatives, both state and federal,

Page #2

General Sibley

informed and seek their aid so that the proposed flood control work can be completed as soon as feasibly possible.

Yours very truly,

Frank J. Carron

John A. Bright Jr.

Joseph V. Sullivan

BOARD OF SELECTMEN
CANTON, MASSACHUSETTS

CGB:M



Town of Canton, Massachusetts

PUBLIC WORKS DEPARTMENT

MEMORIAL HALL

J. Edward Bamber

Supt.

February 20, 1959

Mr. Alva Armstrong
U.S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Dear Mr. Armstrong:

Re: Local Flood Protection Project-Canton, Mass.

With reference to the above project, I am enclosing copies of the Warrant of the Annual Town Meeting of the Town of Canton, Mass.

Article 27 of the warrant pertains to the proposed Local Flood Protective Project.

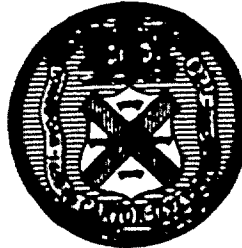
Very truly yours,

J. Edward Bamber
Supt. of Public Works

JEB/t

WARRANT

Annual Town Meeting



COMMONWEALTH OF MASSACHUSETTS

NORFOLK, ss.

To either of the Constables of the Town of Canton.

GREETING:

In the name of the Commonwealth of Massachusetts you are hereby required to notify and warn the inhabitants of Canton qualified to vote in elections and Town affairs to meet in Memorial Hall, in said town on

MONDAY, THE SECOND DAY OF MARCH, 1959

at eight o'clock A.M., then and there to act on the following articles, namely:

Article 27. To see if the Town will vote to authorize the Board of Selectmen to enter into agreements with the United States of America for East Branch of Neponset River Local Protection Project and to execute assurances to the United States of America that the Town will provide without cost to the United States, all land easements and rights-of-way necessary for the construction of the project; hold and save the United States free from damages due to the construction works; maintain and operate all the works after completion in accordance with the regulations prescribed by the Secretary of the Army; contribute all construction funds that are found to be necessary over and above the sum of \$400,000, if such additional funds are required to provide a complete and effective project; arrange for and bear the cost of relocation of all utility lines and raising of bridges where they interfere with the proposed work in connection with the flood control work authorized by the Federal Government pertaining to said project.

COPY OF LETTER RECEIVED FROM

J. EDWARD BAMBER
SUPERINTENDENT OF PUBLIC WORKS
TOWN OF CANTON, MASS.

J. Edward Bamber

23 December 1958

Mr. Adam E. Sulesky
Director and Chief Engineer, Sewerage Division
Metropolitan District Commission
20 Somerset Street
Boston, Massachusetts

Re: Flood Protective Project - Canton, Mass.

Dear Mr. Sulesky:

In connection with my conference with you in your office yesterday, I submit additional information concerning the proposed flood protective project under Public Law 685 on the East Branch of the Neponset River.

A copy of this letter is to be sent to Mr. Alva Armstrong of the New England Division Engineer's Office, Corps of Engineers, U. S. Army, 424 Trapelo Road, Waltham 54, Mass., and he will then send you a copy of the plan.

As proposed the diversion channel will cross the Metropolitan Sewer in Canton in Section 120 in two places. One crossing will be at station 18+20+ in Section 120 and the other crossing will be at station 12+50+.

The proposed grade of the diversion channel bottom will leave about three (3) foot of cover over the Metropolitan Sewer at station 18+20+, while at station 12+50+ the proposed channel bottom will be about one (1) foot above the existing ground level.

It will be necessary to raise the grade of the manhole frames and covers of two manholes. These manholes are at station 16+95 and at station 19+35.

In addition alterations will be necessary to the town sewer which presently ties into the Metropolitan sewer at the 10" branch connection

- 2 -

at station 17+80. It is proposed to abandon part of this 8" sewer and connect to the Metropolitan sewer at the manhole at 16+95.

Your Commission's approval is requested of the proposed flood control project insofar as it affects any interest of structures, easements and rights of way within the jurisdiction of the Metropolitan District Commission.

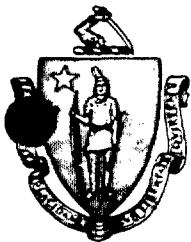
For any additional information please feel free to contact the Corps of Engineers or myself.

Very truly yours,

Supt. of Public works

JEB/t
Copy to Corps of Engineers

C
O
P
Y



The Commonwealth of Massachusetts
Department of Public Works
Division of Waterways

100 Nashua Street, Boston 14

December 30, 1958

Brig. General Alden K. Sibley
Division Engineer
U. S. Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

Dear Sir:

The Massachusetts Legislature has appropriated \$500,000.
to underwrite local assurances for projects proposed to be undertaken
by the Corps of Engineers under U. S. Public Law No. 685.

This Division will therefore provide any necessary funds
in excess of your statutory limit of \$400,000. should the need arise,
for the East Branch of the Neponset River project in the Town of
Canton.

Very truly yours,

Rodolphe G. Hesette
RODOLPHE G. HESSETTE
Director, Division of Waterways



The Commonwealth of Massachusetts
Metropolitan District Commission

20 Somerset Street, Boston 8

January 19, 1959

U. S. Army Engineer Division, New England
Corps of Engineers
424 Trapelo Road
Waltham 54, Massachusetts

File No. NEDGW

Attn: Division Engineer
John W. Leslie, Chief, Engineering Division

Gentlemen:

Examination of your preliminary plans for the proposed diversion channel on the East Branch of the Neponset River at the Plymouth Rubber Company, Canton, Massachusetts, discloses the following conditions concerning the Metropolitan trunk sewer, manholes, and connections:

1. The 60 foot channel will cross the Metropolitan sewer at Sta. 15+75 $\frac{1}{2}$ of the channel with cover of 6.25 ft. $\frac{1}{2}$.
2. The channel will again cross the Metropolitan sewer at Sta. 8+90 $\frac{1}{2}$ of the channel with cover of 3.25 ft. $\frac{1}{2}$.
3. Two Metropolitan manholes are listed to be raised 3.5 to 4.0 ft. $\frac{1}{2}$ and three other Metropolitan manholes may have to be raised because of embankments or filling.
4. Blasting, or rock excavation, may possibly be done within 45 ft. $\frac{1}{2}$ of the Metropolitan sewer near Sta. 7+00 of the channel.
5. An 8" sanitary sewer and manhole belonging to the Town of Canton and connecting to the Metropolitan sewer are to be relocated and reconstructed.

The Sewerage Division will, upon notification that the work should be done, be responsible for the raising of the manholes affected by the construction.

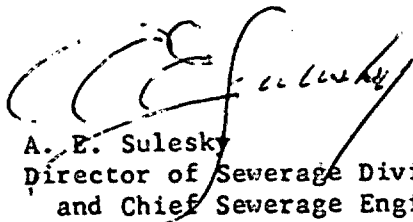
Upon request of the Town of Canton, permission will be granted to it to relocate its connection to the Metropolitan sewer to the manhole indicated on your plans.

Jan. 19, 1959

It is requested that sufficient care be exercised in the blasting, or rock excavation, in the vicinity of Sta. 7+00 of the channel so that no damage will occur to the unreinforced concrete Metropolitan trunk sewer. It is also requested that care be taken where the channel crosses the Metropolitan sewer so that the contractor's operations and equipment will cause no damage.

One set of your preliminary plans are being returned showing the sections of Metropolitan Sewer which are in ledge, according to our construction records.

Very truly yours,


A. E. Sulesky
Director of Sewerage Division
and Chief Sewerage Engineer

AESSt

cc: A. McNair, Dist. Supv. of Sewers
J. Edward Bamber, Supt., Town of Canton

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Amherst, Massachusetts

May 26, 1958

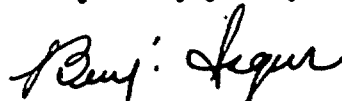
U. S. Army Engineer Division, New England
Division Engineer, Corps of Engineers
150 Causeway Street
Boston 14, Massachusetts

Dear Sir:

This is in reply to your proposed flood prevention work in the town of Canton, Mass., in the vicinity of the Plymouth Rubber Company plant.

We have reviewed your plans for flood prevention work at the Plymouth Rubber Company plant in Canton, Mass. We have no projects or requests for assistance in this area and your proposed works will not affect us in any way at the present time.

Very truly yours,



Benjamin Isgur
State Conservationist

CONNECTICUT
MAINE
MASSACHUSETTS
NEW HAMPSHIRE
NEW JERSEY
NEW YORK
RHODE ISLAND
VERMONT

U. S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS
REGION ONE

1705 Federal Building
Boston 9, Massachusetts

August 18, 1958

Flood Protection
Canton, Massachusetts

Miles L. Wachendorf, Lt. Colonel
Corps of Engineers
Asst. Division Engineer for Civil Works
New England Division
150 Causeway Street
Boston, Massachusetts

Dear Colonel Wachendorf:

The proposed flood protection projects for Canton, Massachusetts as described in your letter of May 12, 1958 have been reviewed by this office. At this time, such projects will have no effect on any proposed highways in this area.

Thank you for your concern in informing us on this matter.

Very truly yours,



Charles E. Hall
Division Engineer

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE

PUBLIC HEALTH SERVICE
Region II
42 Broadway
New York 4, N.Y.

July 18, 1958

Refer to: 24:SE
Reference: NEDGW

Lt. Col. Miles L. Wachendorf
Asst. Division Engineer for Civil Works
U. S. Army, Corps of Engineers
New England Division
150 Causeway Street
Boston 14, Massachusetts

Dear Colonel Wachendorf:

Reference is made to your letter of May 12, 1958 regarding projects for flood protection in the Town of Canton, Massachusetts.

We have reviewed the alternate plans for the projects with the Massachusetts Department of Public Health and find no indication that any of the proposed work would affect any source of public water supply.

It is noted on the drawing "East Branch Neponset River, Diversion Canal" that the profile of the channel does not show the MDC sewer crossing at Sta. 15+80. While the sewer is shown in Section A-A we suggest it also be located on the profile.

Our vector control section after review of the plans does not envision that any significant vector problems will be created by construction of any of the proposed projects. If unexpected mosquito problem areas should develop, technical assistance for remedial measures may be obtained from the Massachusetts Department of Public Health or the Public Health Service.

We have no other comments on the water supply, pollution control or vector control aspects of the project at this time.

For the Regional Engineer.

Sincerely yours,

E. J. Anderson

For Lester M. Klashman
Acting Assistant Regional Engineer
Water Supply & Water Pollution Control



IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
OFFICE OF REGIONAL DIRECTOR
BLAKE BUILDING
BOSTON 11, MASSACHUSETTS

REGION 8
NEW ENGLAND STATES
NEW YORK
PENNSYLVANIA
NEW JERSEY
DELAWARE
WEST VIRGINIA

September 22, 1958

Division Engineer
New England Division
U. S. Corps of Engineers
150 Causeway Street
Boston 14, Massachusetts

Dear Sir:

Reference is made to your letter of May 12 in which you describe three possible local flood protection projects in the town of Canton, Massachusetts. You requested comments from this Bureau relative to the effects of this project on the fish and wildlife resource.

The proposed local protection measures would have no appreciable effect on the fish and wildlife resource. A report by this Bureau is not required.

Your consideration in keeping this office informed of your local protection activities is greatly appreciated.

Sincerely yours,

M. A. Marston
Chief
Division of Technical Services



TOWN OF CANTON
MASSACHUSETTS

March 18, 1959

At the annual Town Meeting, of the Town of Canton, held in the new High School, on March 9, 1959 and subsequently adjourned until March 16, 1959 the following article appeared in the warrant for said meeting:

Article 27. To see if the Town will vote to authorize the Board of Selectmen to enter into agreements with the United States of America for East Branch of Neponset River Local Protection Project and to execute assurances to the United States of America that the Town will provide without cost to the United States, all land easements and right-of-way necessary for the construction of the project; hold and save the United States free from damages due to the construction works; maintain and operate all the works after completion in accordance with the regulations prescribed by the Secretary of the Army; contribute all construction funds that are found to be necessary over and above the sum of \$400,000.00, if such additional funds are required to provide and complete an effective project; arrange for and bear the cost of relocation of all utility lines and raising of bridges where they interfere with the proposed work in connection with the flood control work authorized by the Federal Government pertaining to said project.

VOTED: That this article be adopted and the sum of \$10,000.00 raised and appropriated.

A true copy,
ATTEST:

Maurice E. Ronayne Jr.
Maurice E. Ronayne, Jr.
Town Clerk

PLYMOUTH RUBBER COMPANY, INC.

THE LARGEST MANUFACTURER OF RUBBER PRODUCTS IN THE WORLD

RUBBER STAMPS
QUARTERLY NEWS
HOSPITAL RECEIPTS
PLASTIC GARDEN HOSE
ELASTIC TAPES



RECORDS - LEXINGTON - PORTFOLIOS
PLASTIC - PHOTOGRAPHS
PLASTIC - LITHO AND SHEET NO.
PLASTIC - ADHESIVE WALLPAPER
RUBBER BANDS

CANTON, MASS., U.S.A.

TELEPHONE CANTON 6-0220

March 6, 1959

Board of Selectmen
Town of Canton
Canton, Massachusetts

Gentlemen:

This is to inform you that by vote of the Board of Directors on January 14, 1959, it was agreed that the Plymouth Rubber Company, Inc. will enter into an agreement with the Town of Canton and with the Government of the United States in respect to "Local Flood Protection Work - East Branch of Neponset River" as follows:

We hereby agree to provide all land, easements and rights of way necessary for the construction of the above-mentioned project within the Plymouth Rubber Company, Inc. lands; to save the United States free from damages due to such construction work; and to lower where necessary a 6" cast iron water main.

However, it is expressly understood that the above grants and agreements of Plymouth Rubber Company, Inc. are limited solely to the project as discussed between Messrs. Frank Harris and Whitfield Vye of the Plymouth Rubber Company, Inc., Mr. J. Edward Bamber, Supt. of Public Works for the Town of Canton, and representatives of the Corps of Engineers of the United States Army, all as outlined on Topography drawing supplied by the Corps of Engineers entitled East Branch Neponset River - Diversion Canal - Canton, Massachusetts, (photostatic copy of title section attached).

Very truly yours,
PLYMOUTH RUBBER COMPANY, INC.

JMH
Joseph M. Hamilburg
President

JMH:m
Enc.

EXHIBIT 13

PLYMOUTH RUBBER COMPANY, INC.

CERTIFICATE OF CORPORATE VOTE

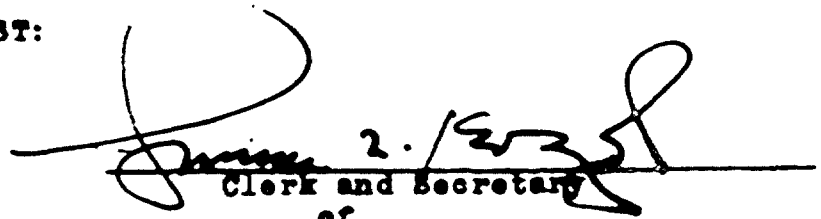
I, FRANK L. KOZOL, Clerk and Secretary of PLYMOUTH RUBBER COMPANY, INC., a Massachusetts corporation, do hereby certify that at a meeting of the Board of Directors of said Corporation, duly called and held on January 14, 1959, at which meeting a quorum of the Directors was in attendance and voting, the following vote was unanimously passed, to wit:

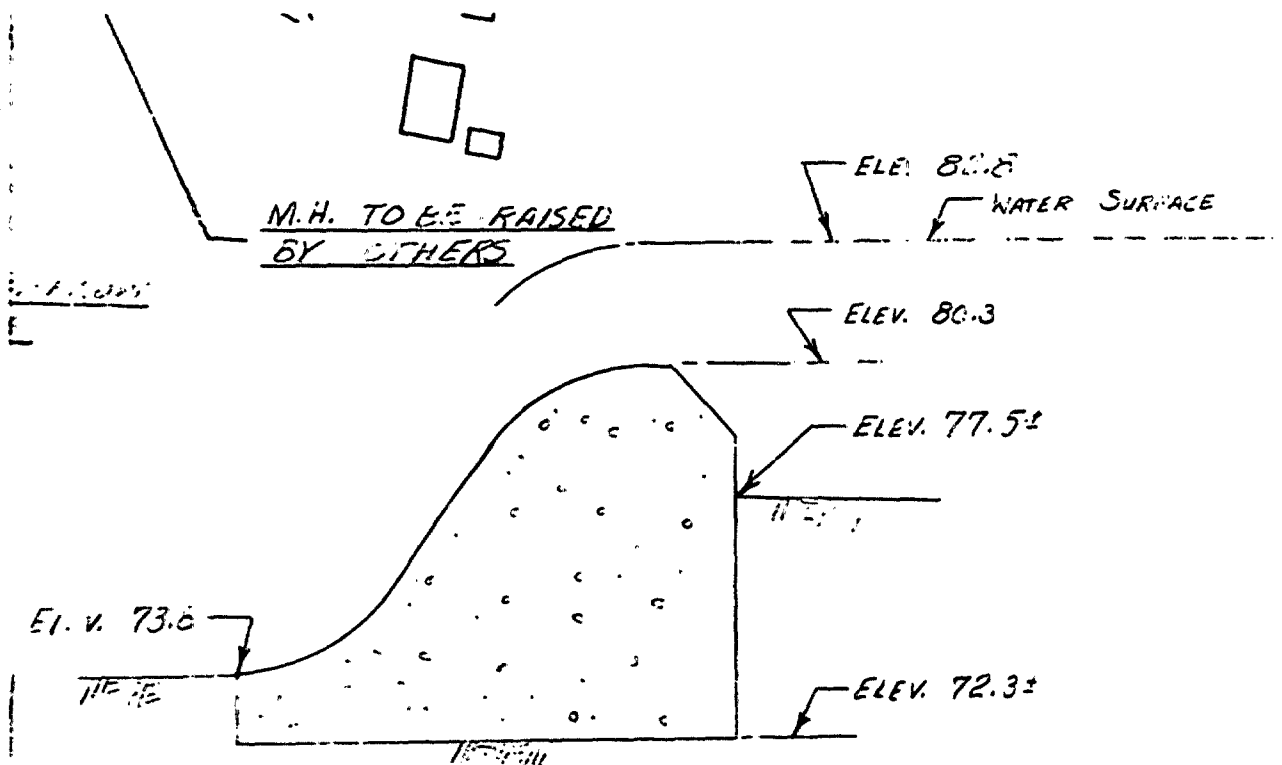
VOTED: That Joseph M. Hamillburg, President is hereby authorized and empowered, in the name and on behalf of Plymouth Rubber Company, Inc. to make whatever agreement with the Town of Canton, and with the Government of the United States that he deems to be proper and desirable in respect to "Local Flood Protection Work - East Branch of Neponset River", and if said President so determines to include in such agreement provisions for the conveyance or grant by way of fee, easement, right of way or otherwise of such lands of Plymouth Rubber Company, Inc. as he, said President, shall decide, and to execute and deliver such permissions, indemnities and releases in connection with the foregoing as he, said President, shall decide.

I further certify that the foregoing vote is in full force and effect, and has not been amended, altered, rescinded or repealed.

IN WITNESS WHEREOF I have hereunto affixed my name and the seal of said Corporation this 28th day of February, 1959.

ATTEST:


Clerk and Secretary
of
Plymouth Rubber Company, Inc.



SECTION F-F

PRELIMINARY		
DESCRIPTION		BY
CORPS OF ENGINEERS U. S. ARMY OFFICE OF THE DIVISION ENGINEER NEW ENGLAND DIVISION BOSTON, MASS.		
DESIGNED BY M.R.H. L.R.M.	TOPOGRAPHY <h2 style="margin: 0;">EAST BRANCH NEPONSET RIVER</h2> <h2 style="margin: 0;">DIVERSION CANAL</h2>	
SECTION	CANTON MASS.	
BY		
CORPS BRANCH	APPROVED DATE	
ENGINEERING DIV.	COL. C. E. DIVISION ENGINEER	
SCALE: 1" = 50'		DRAWING NUMBER
SHEET / OF /		